



BENCHMARK VISIT REPORTS

Benchmark visit 1

Benchmark visit 2

Lessons learned

WEB Version

01.2019





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A. Benchmark Visit 1

DATE: 29th and 30th of November 2018

LOCATION: Graz, Austria



Figure 1. Project team at Childcare centre Maria Enzersdorf (source: InAirQ team)

First day, 29th of November 2017

Project partners visited the school Childcare centre Maria Enzersdorf near Vienna. The visit was guided by the author of the school, architect Stefanie Wögrath and representative of the Municipality Vienna. They showed us the school, with the focus on ventilation systems and indoor air quality. Moreover, they explained us how the situation with school building and renovations in Vienna is.

A.1. Childcare Centre Maria Enzersdorf

Architect: MAGK + illiz architektur



Figure 2. Classrooms - windows: natural light, natural ventilation (source: InAirQ team)



Figure 3. Corridors (right: ventilation line - connection between corridor and classroom) (source: InAirQ team)



Figure 4. Special recreational room (source: InAirQ team)



Figure 5. Visual and direct connection with outdoor environment (source: InAirQ team)

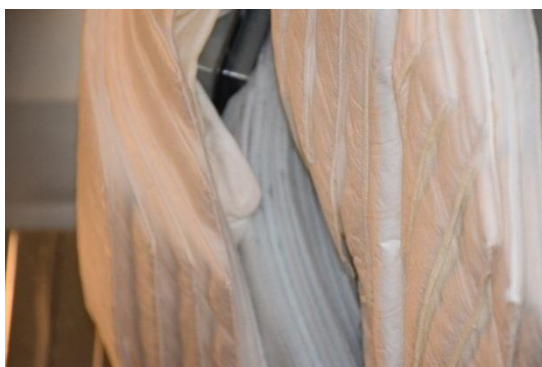


Figure 6. Filters - mechanical ventilation (source: InAirQ team)



Figure 7. MEP room (source: InAirQ team)



Figure 8. Outdoor space (source: InAirQ team)



Figure 9. Windows (source: InAirQ team)



Figure 10. Gym (source: InAirQ team)



Figure 11. Floorplan (source: InAirQ team)

ABOUT THE SCHOOL AND SCHOOL BUILDING*:

Architects: MAGK+illiz architektur

Project Architects: Günter Klein, Sabrina Peters, Martin Aichholzer, Petra Schlömer, Stefanie Wögrath

Staff Team: Karin Gutmann, Jiri Koten, Rosemarie Lebzeltner, Christian Eibensteiner, Stefan Kehrer

Area: 9554.0 sqm

The entire building complies with passive house standards. With an innovative ventilation concept, it is possible to achieve a minimisation of costs regarding the operating times of the mechanical ventilation. For this purpose, the classrooms and group rooms are aired by transverse ventilation via acoustic slot openings across the corridor zones without noise from the corridor being transported into the classrooms. This concept also technically ensures that overheating in summer is prevented temperatures dropping at night. The building services engineer was the Viennese office Bauklimatik: <http://www.bauklimatik.at/>.

From the architect. An influx and increasing birth rate in the community situated to the south of Vienna called for the creation of more, particularly state-of-the-art child care facilities. Therefore a competition tender submission for a new child care centre was issued in 2008. The existing 19th century 'Gründerzeit' school was to be extended by eight primary school classes, a after-school care club and a kindergarten with kitchen.



The association of architects MAGK illiz won the competition and was awarded the tender. The draft of the project team MAGK illiz breaks up the construction into L-shaped bodies which are interlaced in such a manner that different places and free spaces to play in and for learning are formed in the interstices.

Good orientation and quick ways for children and adults are provided by a simple routing system between the functional areas of the two-floor ensemble. The new main entrance to the school is also the assembly hall and connects the existing school building with the new building. The façade is developed as a 'pixeled' white envelope. Format and joining patterns of the "window pixels" meet the current utilisation needs whereby the rooms at the back can be interpreted from outside and the recall value of the individual building sections is enhanced. The façade surfaces alternate between smooth and rough plaster which, particularly in grazing light, creates a vivid impression.

Unlike the high-contrast façade, the design of the interior rooms is characterised by varying, finely tuned colour and material combinations. The differing design of doors, cloakrooms and wall panels in an individual range of colour for each area of activity facilitates finding the way and increases their identification, particularly for the children. The cloakrooms of the children's groups are covered in wood and meander like snails shells into private niches.

"Pixels" protrude into the corridors and from the façade; they are used by the children as nests to read and to cuddle up in. All activity areas have green and free surfaces. The playground used for breaks turns into a climbing and adventure scenery by its dazzling orange rubber surface, the roof terrace with the smoothly concreted surface becomes a race course. Crèche and kindergarten form a common one to two floor patio which forms a settled pacified centre surrounded by play corridors, multi-purpose and action rooms. The colourful door and ventilation elements of the room-high glass façade allow a for an event room to emerge which can be used flexibly. There is a two-floor loggia of a white-coated welded grid and coloured glass pain curtain to the west of the group rooms on the left, in front of the kindergarten. It complements the monolithic character of the building and is both a sunshade and fall-protection. Depending on the viewing angle, the façade appears anything from transparent to closed, from the interior, however, it embodies a protective second envelop, allowing the smallest children a glance into the greenery and conjures colourful spots of light in the room.

The material and construction concept is characterised by the high standards imposed on ecological sustainability. To ensure the building period was speedy, the new construction was setup in a composite construction method with a solid core as storage mass and a prefabricated, high-insulation envelope of timber frame construction, of solid wood panel structure respectively.

The entire new building complies with passive house standards, the aim of which is greatest ease and comfort for the user at lowest possible operating costs.. With an innovative ventilation concept it is possible to achieve a minimisation of costs with regard to the operating times of the mechanical ventilation. For this purpose the classrooms and group rooms are aired by transverse ventilation via acoustic slot openings across the corridor zones without noise from the corridor being transported into the classrooms. This



concept also technically ensures that overheating in summer is prevented temperatures dropping at night. Thanks to efficient cost control the overall budget could also be used to redevelop and renovate the existing gym in the scope of this extension. Furthermore, the circulating strip lights could be renewed and provided with circumferential horizontal, partially movable sun protection louvers.

The childcare centre of MAGK illiz is characterised particularly sensitively by the traditional, small dimension structure of the surroundings. The broken building volume is so interlaced that it by no means competes with the environment.

Together with the existing classrooms, the new primary school, the crèche and the kindergarten form one of the largest childcare centres in Lower Austria after a mere period of three years needed for planning and building.

**Source: <http://www.archdaily.com/199345/childcare-centre-maria-enzersdorf-magk-illiz>*

Second day, 30th of November 2017

Project partners visited two school buildings in Graz:

1. Volksschule Graz-Mariagrun
2. Primary School Hausmamstaaten.

The visits were organized by Armin Knotzer from AEE - Institute for Sustainable Technologies, in collaboration with the headmasters of both schools. They showed us the school, with the focus on ventilation systems and indoor air quality.

More info about the institute AEE - Institute for Sustainable Technologies and project RENEW SCHOOL:

www.renew-school.eu

<http://www.aee-intec.at>

A.2. Volksschule Graz-Mariagrün

More info about the school:

<http://www.volksschule-mariagruen.at/>



Figure 12. Indoor and outdoor learning space (source: InAirQ team)



Figure 13. Classroom and dynamic learning space (source: InAirQ team)

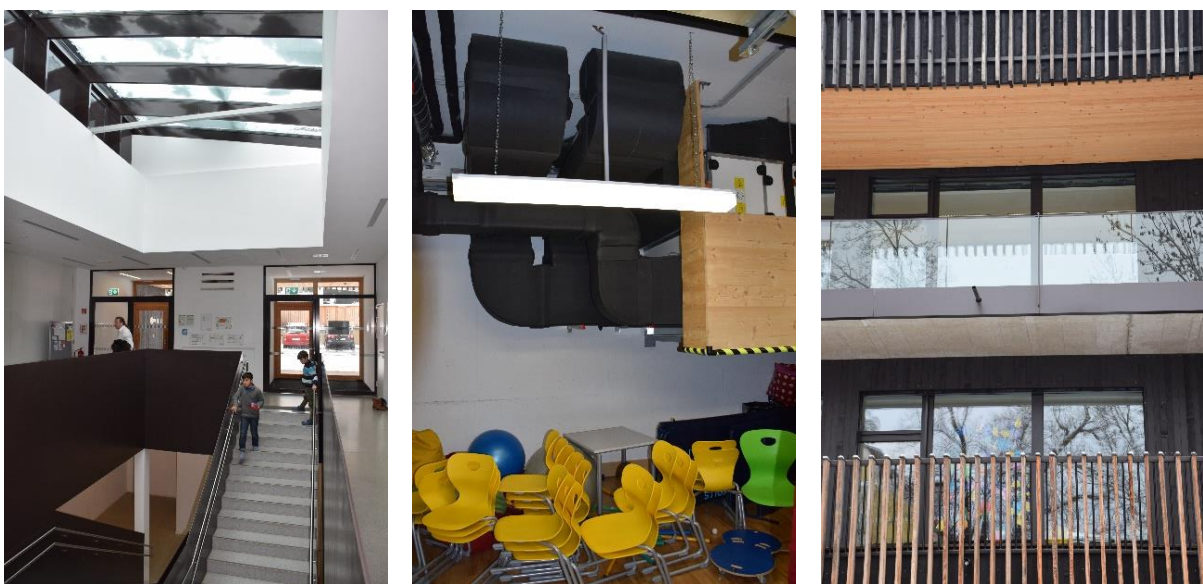


Figure 14. Atrium, mechanical ventilation and façade (source: InAirQ team)



Figure 15. Façade (source: InAirQ team)

A.3. Primary School Hausmannstätten

Location: Hausmannstätten, Austria



Figure 16. Façade (source: InAirQ team)



Figure 17. Classrooms (source: InAirQ team)



Figure 18. Corridors (source: InAirQ team)



Figure 19. Façade (source: InAirQ team)

B. Benchmark Visit 2

DATE: 21st and 22nd of May 2018

LOCATION: Espoo and Sipoo, Finland



Figure 20. Project team in Sipoo (source: InAirQ team)

First day, 21st of May 2018

Project partners visited the Saunalahti school in Espoo. The visit was guided by the Vice President of the school, Minna Welin. They showed us the school, with the focus on ventilation systems and indoor air quality. Moreover, they explained us the new school curriculum, which was accepted on the national level in 2016 and which has a big influence on the design of the school buildings.

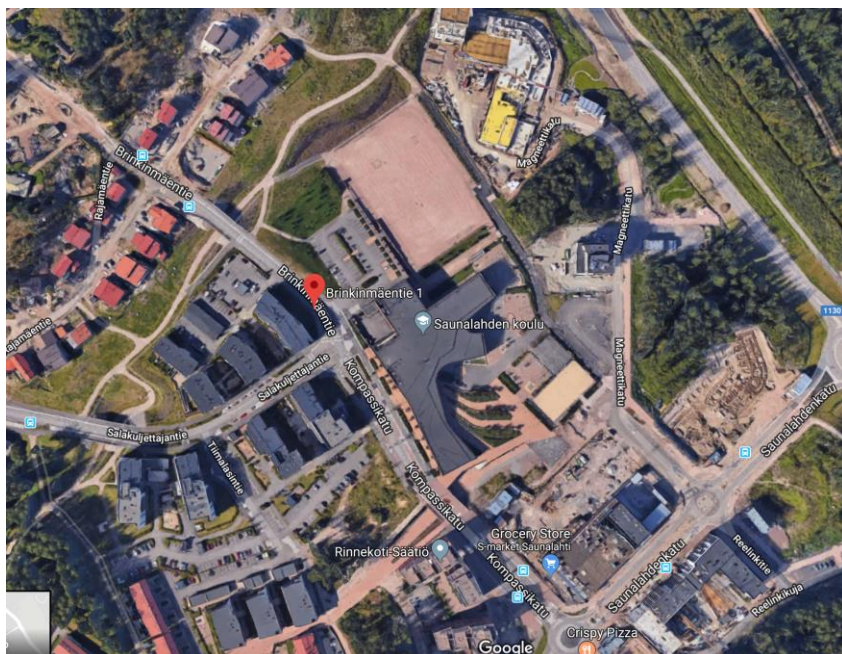


Figure 21. Urban plan (source: Google Maps)



Figure 22. School as part of the neighbourhood and wider urban plan (source: InAirQ team)



Figure 23. Presentation about the school, Vice President (source: InAirQ team)

The School of future in Saunalahti: the first school integrated multipurpose building in Espoo: full day day-care center, school, public library, youth centre and many activities after schooldays. The design of this house has emphasized safety and flexibility, fitted on the site and is very aesthetical. It was designed by **Verstas Architects**. It presents the Centre of the new area, the first big building in this area.

VISION: The inclusive Saunalahti school is a learning and expert community that enables growing roots and wings to children.

VALUES: Focused on child. Integrity and fairness. Tolerance and equality. Sustainability. Sense of community. Holistic wellness.

MISSION: “A child is not brought up so that he can be as pleasant and effortless for us as can be, but so that he can be healthy and strong to fill in his future place in the world and discover himself.” Maaria Jotuni

THE SCHOOL OF FUTURE IN SAUNALAHTI: they will be growing year by year; grades 0 to 9, app. 800 pupils (2018), staff about 100; the architects have considered pedagogical needs of the school; emphasis on drama, art, music, literature, handicrafts, dance.

SCHOOL YEAR 2017-18: 70 children in preschool (age of 6), 170 first and second graders, 75 third graders, 75 fourth graders, 75 fifth graders, 65 sixth graders, 60 seventh graders, 60 eight graders; about 700 children all together; about 100 adults works with them.

HOW AND WHERE DO WE WANT TO LEARN: Different places for learning; outside and under the table; Movement and rhythm; standing up; Different ages learning from each other; Each one teaches one; Through play and games; ICT as a tool; Solving real problems; Making things with your own hands; different art forms; Awareness of your own learning and “why am I doing this”; meaningfulness.



Figure 24. Classroom: mechanical ventilation (source: InAirQ team)



Figure 25. Classroom (source: InAirQ team)

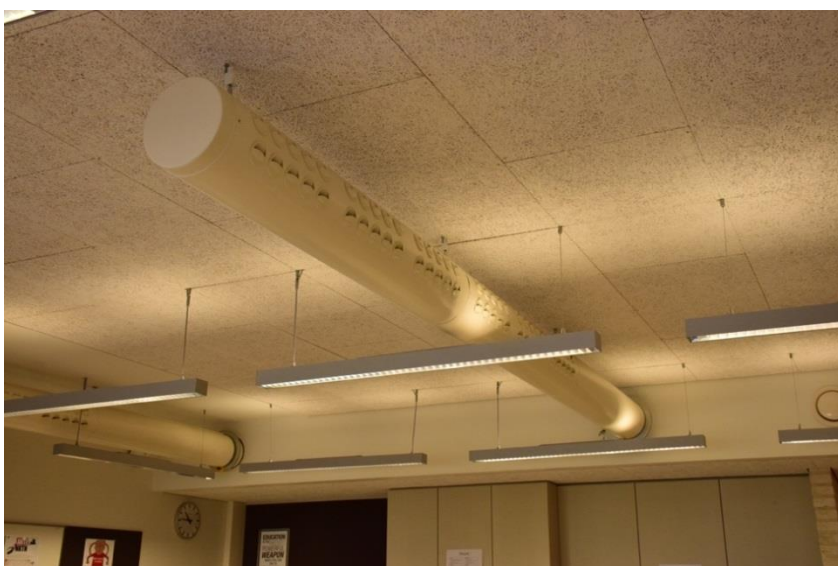


Figure 26. Detail: mechanical ventilation in classroom (source: InAirQ team)



Figure 27. Project team in front of the school (source: InAirQ team)



Figure 28. Glass façade (source: InAirQ team)



Figure 29. Details - windows on the façade, wooden façade (source: InAirQ team)

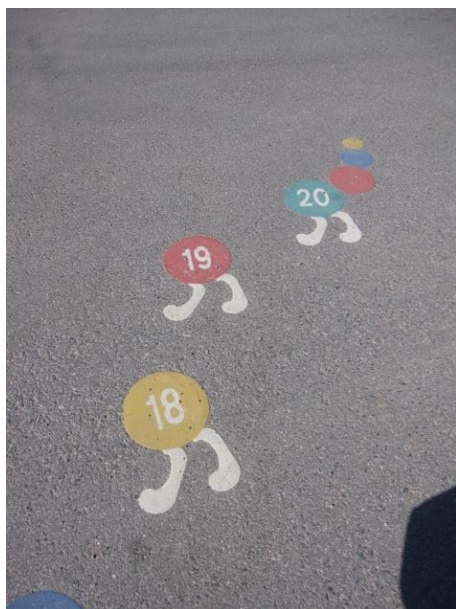


Figure 30. Additional learning tools (outdoor) (source: InAirQ team)



MORE ABOUT THE SCHOOL: SAUNALAHTI SCHOOL*, VERSTAS ARCHITECTS

<https://www.archdaily.com/406513/saunalahti-school-verstas-architects>

Architects: VERSTAS Architects

Location: Espoo, Finland

Design Team: Väinö Nikkilä, Jussi Palva, Riina Palva, Ilkka Salminen

Main contractor: YIT Rakennus Oy

Interior design: Karola Sahi in collaboration with Verstas Architects

Area: 10500.0 sqm

Project Year: 2012

In the “Future School” educational activities will increasingly take place outside the traditional classroom and introduce new ways of learning. Saunalahti school is a building tailored to support the pedagogical ideas of a forward-looking school. In its operation, the school puts special emphasis on new ways of learning, art and physical education and collaboration. The building supports these ideas by creating places for interaction of various scales and atmospheres.

“Learning by doing”: Learning and doing with one’s own hands improves learning results. Art and physical education versatily contribute to good learning and growth. In Saunalahti school these teaching spaces have been dedicated a prime location in the building. The workshops open through glass walls to the street and the school yard.

“Out of the classroom”: The spatial organization of Saunalahti school supports learning also outside of the classrooms and encourages kids to use the school spaces in open-minded and unorthodox ways. Every interior and exterior space is a potential place for learning.

“Interaction and collaboration” In addition to classes 1 to 9 of the comprehensive school, Saunalahti school houses a day care centre, preschool, youth house offering leisure activities and a small library combining the functions of communal and school library. In evenings and weekends different operators organize clubs and activities bringing together different user groups. The gymnastics premises are in communal use and the local residents actively use the sport fields and play grounds of the school yards. The building with its versatile array of services becomes the meeting point for the families in the area.

Common building for the whole community: Saunalahti school is a multi-purpose building for education and culture. The school is closely linked to the future central square of the new residential area of Saunalahti and its open character makes it an active part of the everyday environment of the residents.

The building is set on the site in a way that makes the school yards as safe and as comfortable as possible. On the west side the building borders the street while on the southern and eastern sides the main spaces openly connect to the square and the future



residential area through the school yards. The building forms a sheltering background to the school yards, protecting them from the traffic and noise of the street. Main entrances are from both the street and the yard side. The home areas have their own entrances from the yard.

The school yards are divided by the building into areas with favourable conditions for children of different ages. The youngest children with shorter school days enjoy sunlight in the morning and midday hours on their cosy yard. The older kids part of the yard is more closely connected to the square and continues receiving sunlight over the lower workshop wing until late in the afternoon. The two sports fields and the equipment for exercise and play scattered around the school yards are used not only during the school days but also by the locals on evenings and weekends.

The topography of the site has been utilized in the terraced yard which winds around the front of the dining hall forming an outdoor theatre. The theatre integrates the interior and exterior worlds into a single spatial whole. The theatre stage is situated at the joint between the school yards for the older and younger children.

Functionality of the building: The functions and spaces are organized like a city into public, semi-public and private areas depending on the activity and the age of the children.

The most public space and the space where all different user groups meet is the multi-purpose dining hall - the heart of the building. The stage opens to the dining hall which also serves as the festival hall of the school. The auditorium and the small library combining the functions of communal and school library are situated next to the heart space and the main entrance. The heart space and its stairs and balconies provide views over the outdoor auditorium and beyond to the central square of Saunalahti area, somewhat like a Greek theatre set into the mountainous landscape. The spatial organization of the building and the stimulating school yard encourage children to go outside during the breaks to play and move around.

Classrooms for the smaller children are organized into home areas with their own separate small scale lobbies with views to the school yards. The lobbies are used for group work and are closely connected both to the classrooms and to the heart space. The day care centre on the ground floor has its own yard on the quietest corner of the site. The older children's classrooms and the administration are placed to the second floor around the heart space.

The spaces for art and physical education comprise the workshop area between the street and the school yards. The spaces including workshops for cooking, music, wood, metal and textile handicrafts reveal the action to the surroundings through large openings to the street and the student work gallery toward the school yard. The youth house is placed to the southernmost part of the building next to the workshops and the future central square, providing it with a distinct atmosphere suitable for the leisure activities. The gymnastics halls on the ground floor can be used separately from the rest of the building through the entrances on the northern side.

Façades and materials: The scale of the building varies according to the functions and the age of the children both in the façades and inside the building. The free-from shape



of the new school building follows the terrain. The roof, undulating to provide the optimal sun light conditions for the school yards, takes the shape of a soft meandering landscape. From the central square and the neighbouring apartment buildings the copper roof forms the fifth façade of the building.

The vast light central heart space of the building is emphasized by the characteristic free-form ceiling that echoes the form of the roof. Massive walls of cast on site concrete support the laminated timber beams that are left visible on the eaves outside the large glass wall of the space. Energy-efficient solutions - such as efficient heat recovery ventilation, highly controlled lighting and solar power - are used in the building.

Authentic materials used both on the façades and in the interiors are durable and give the building a warm and relaxed atmosphere - rough red brick, warm wood, concrete and copper on the façades and oak, concrete and light coloured rough surfaced brick in the interiors.

Subtle colours are used in the interiors in combination with the real colours of the surface materials to give the spaces warm and peaceful atmosphere suitable for learning. Brighter colours are used sparingly. The staircases and other spaces for circulation of different parts of the building have their unique signal colours. The colour scape of the furniture and signs of these areas echo the colours of the to help orientation in the large building.

The brick façades utilize the versatile properties of brick, comprising a collage of different brick-laying and bonding techniques. The layered belts of different brick bondings create an intermediate scale to the façade of the large building and emphasize the undulating eave line of the walls. The wooden façades facing the school yards are sheltered by long eaves.

Source: <https://www.archdaily.com/406513/saunalahti-school-verstas-architects>

Second day, 22nd of May 2018

Project partners visited the Municipality Sipoo. The visit was organized by Suvi Tuiskunen. First, they presented us how they are dealing with the topic IAQ in schools, what are specifics about the planning process and their new curriculum, and then they showed us few schools.

Day's Agenda:

- Welcome to Sipoo and general info and presentation (Suvi Tuiskunen and Lari Siren)
- Schools in Sipoo
- Good indoor quality as a basic requirement for all buildings
- Good indoor air quality and building projects: The process for good indoor air (Juha Pohjonen), Air ventilation system management in Sipoo (Pekka Nirhamo), Centre of education Nikkilan Sydan
- Visiting two schools in Nikkilan
- Visiting Village school
- Soderkulla School in Opintie

- Additional presentation on air quality Willa Soder



Figure 31. At the municipality Sipoo (source: InAirQ team)



Figure 32. Meeting with the representatives of the municipality (presentation) (source: InAirQ team)

Department for Built environment: Development and support, Real estate management, Street infrastructure, Water supply and sewage, Building control, Environmental protection

Population is Sipoo: app 20.000; one of the fastest growing municipalities in Finland, expected population growth is 600-800 inhabitants / year; bilingual municipality: Finnish and Swedish

The Sipoo's philosophy in planning is based on the triplet of: pedagogy (the new curriculum), space efficiency (economy) and architecture.

Good indoor air quality is important in all building projects.



Figure 33. Construction work in Nikkila (we visited it) (source: InAirQ team)

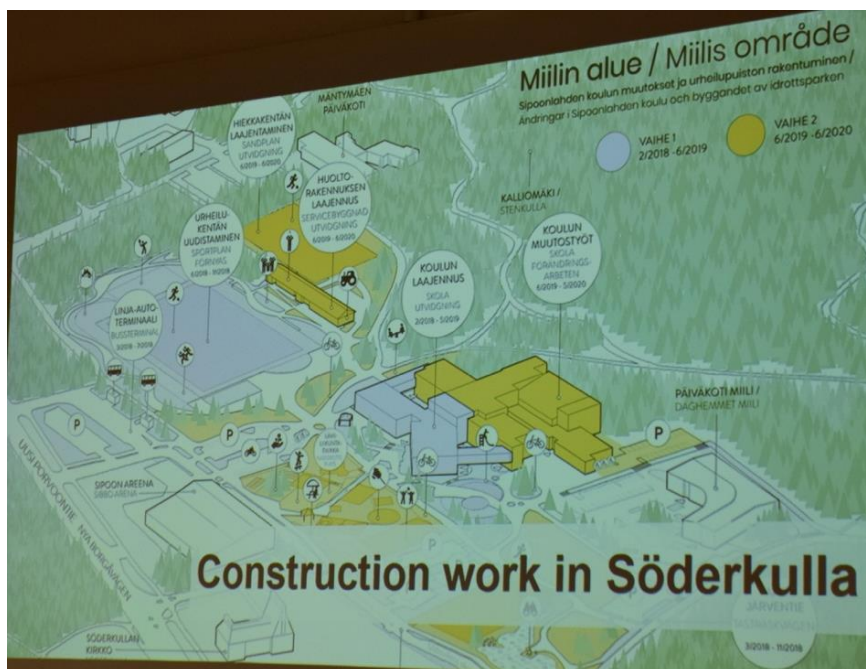


Figure 34. Construction work in Soderkulla (we visited it) (source: InAirQ team)



Figure 35. MEP room (source: InAirQ team)

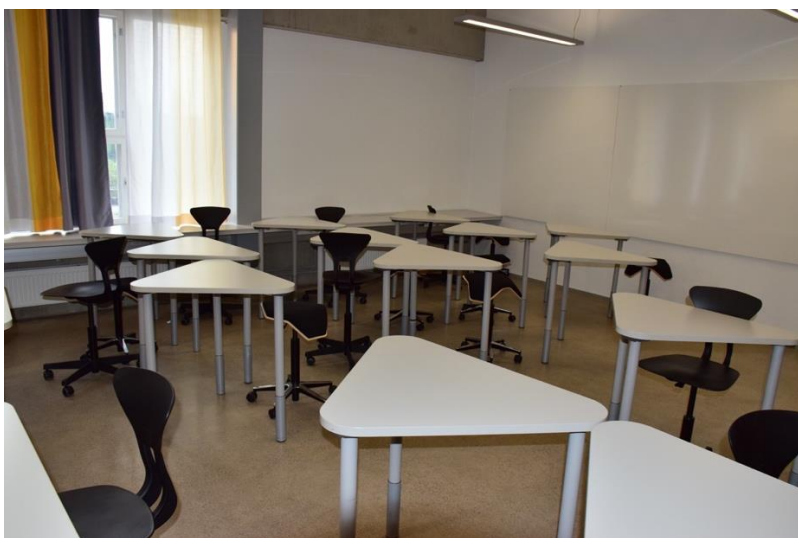


Figure 36. Classroom (source: InAirQ team)



Figure 37. School: playgrounds (source: InAirQ team)



Figure 38. Village school (source: InAirQ team)



Figure 39. Classrooms in village school (source: InAirQ team)



Figure 40. School (source: InAirQ team)



Figure 41. School that has been decided to be tear down due to bad air quality, nearby they will build new school (source: InAirQ team)



Figure 42. Gym (source: InAirQ team)



Figure 43. Project team in front of the construction site for one school (source: InAirQ team)

SCHOOLS IN FINLAND

(information provided by the Municipality Sipoo)

General information

All the building projects in Finland need to be done according to the Finnish Building Code which is based on The Land Use and Building Act (132/1999). The Building Code specifies



for example the appropriate level of carbon dioxide, humidity and temperature that are allowed in the class room.

Also, another guideline that defines the school environment is the school curriculum. In Finland the new curriculum for primary and secondary school was launched in 2016 (and also for the early childhood education a bit later). The curriculum also affects the design and planning of the school buildings. According to the new curriculum the learning environments become more versatile. The old classroom-based teacher-drawn learning transforms into learning by experiencing and phenomenon-based learning. That also means new requirements for the learning environments. The learning environments can be living room -like spaces for one or many classes to small quiet spots for one person. The curriculum emphasizes that the learning environments can be found in- or outdoors which means that the schools no more just a building but it expands into nearby playgrounds, forests and nature.

"Sipoo is growing rapidly at the moment, which forms a great challenge in building enough schools and kinder gardens for the new residents." In Sipoo the philosophy in planning the new and renovated school buildings is based on the triplet of pedagogy (the new curriculum), space efficiency (economy) and architecture. The buildings are planned to enable multiple uses which rises the utilization rate of the building. All the projects are done in cooperation between the departments of real estate management and education of Sipoo municipality. The good indoor quality is a basic requirement for all buildings.

New and extended buildings:

Nikkilän Sydän ("Nikkilä's Heart")

Nikkilän Sydän is a new school building ("educational centre") in the centre of Nikkilä, the administrative centre of Sipoo. The building houses two schools, the Finnish and Swedish speaking secondary schools (grades 7-9). The building was planned to be constructed in two phases. First part of the building was ready in 2016 and the second phase will begin in the summer 2018. After the second construction phase is finished, the Finnish secondary school becomes comprehensive school as elementary school grades 1-6 move in. After that the number of students will be approximately 1000. In addition, the extension of the building also the older spaces are modified into open learning spaces.

Sipoonlahden koulu (The Sipoonlahti School)

Sipoonlahti Comprehensive School is located in Söderkulla, in the southern centre of Sipoo. The school was opened in 2009 for 3.-9. grades. Because the number of children is growing in Sipoo more space is needed and also the old building is found very inefficient when it comes to space efficiency. Thus, the Sipoonlahti school building will be extended (the construction work starting in the summer 2018) and the old building will be completely modified according to the new curriculum. An architect competition was organized to plan the extension part and the modifications of the new school. The project



is very large as the whole school area including parks, playgrounds and streets will be developed.

Renovated building:

Wessman-talo (The Wessman House)

The Wessman House was before a part of a school centre with several other buildings. Some parts of the school centre were already from the 60's and 80's, the spaces were unpractical and some of them had problems with indoor quality. Most parts were torn down and Nikkilän Sydän (presented above) was built to replace them. Wessman House was in good shape and is at the moment being renovated to become a new learning space for the pre-school and for the first and second grade pupils of Nikkilä. The project is ready in the end of the year 2017. In addition to these visits you could possibly get a presentation on the planning of a new kindergarten which construction work will start in April 2018. The kindergarten will be located in the same campus area as Nikkilän Sydän and Wessman House and the planning of the building is based on the same philosophy as the school buildings.

Source: Municipality Sipoo



C. Lessons learned for development of action plans based on benchmark visits

Based on the benchmark visits we prepared the table with the list of lessons learned and proposed action plans.

Topic	Element	Lessons learned from benchmark visits	Proposed action plan
PROCESS IMPROVEMENT	Cleaning process	Using ecofriendly cleaning products	Use cleaning products with the least adverse impact on human health, more natural cleaners, avoid using colours, paints.
	Maintenance	Permanently well maintained building	Regular inspection of the rooms and quick action and remediation in case of leakage of water and accumulation of moisture in the school buildings
	Monitoring	Inspection of building is carried out by the municipality.	Regular inspections of school buildings carried out by municipality.
		Continuous air quality monitoring in classrooms (CO ₂ , T, RH)	Air quality monitors in each classrooms, regular monitoring.
		Monitoring depends on seasonal parameters (RH, T, moisture).	Monitoring depends on seasonal parameters (RH, T, moisture).
		Decentralised/centralised CO ₂ controlled mechanical or hybrid ventilation.	Decentralised/centralised CO ₂ controlled mechanical or hybrid ventilation.
Modern building automation and control system (remote monitoring; performance meter providing summary - informative format)	Modern building automation and control system.		



Topic	Element	Lessons learned from benchmark visits	Proposed action plan
TECHNICAL IMPROVEMENT	Natural ventilation	Not openable windows, there is only mechanical ventilation - big problem	Need for combination of natural and mechanical ventilation.
	Mechanical ventilation	Mechanical extract and supply ventilation with heat recovery (demand controlled ventilation, operated by temperature, CO ₂ and presence detectors)	Plan for maintenance of HVAC system. The plan should include monitoring, inspecting and cleaning HVAC components such as outside air intakes, outside air dampers, air filters, drain pans, heating and cooling coils, the interior of air handling units, fan motors and belts, air humidification, controls and cooling towers.
		Mechanical ventilation in all building.	Mechanical ventilation in all building.
		Intensive air ventilation system in the dining room.	Intensive air ventilation system (mechanical ventilation) in the dining room.
		Night ventilation	Night ventilation
		Innovative ventilation concept.	Innovative ventilation concepts - collaboration with MEP from the beginning of design/planning process, interdisciplinary collaboration, innovative concepts integrated into building design.
	Furniture	Using materials with low emissions	Using materials with low emissions.
	Construction material	Using prefabricated, high quality wooden facade elements (emissions stays in the factory)	Using prefabricated, high quality wooden facade elements (emissions stays in the factory)



Topic	Element	Lessons learned from benchmark visits	Proposed action plan
		Using a lot of concrete with low VOC emission	Using a lot of concrete with low VOC emission
	Windows / glass facade	Big windows surfaces	<i>*Impact on well-being</i>
		Shading system (lower temperature)	Shading systems.
	Flooring:	Mainly parquete (natural element)	Change of flooring with healthy building materials (use of parquet).
	Walls	Walls without any paintings	Less decoration on walls.
	Greenery	A lot of plants in classrooms.	Implementation of plants into classrooms.
FUNDINGS	Owner	Municipality is the owner of the building and have bigger role in the maintainance/ funding distribution etc. (vice president of the school has less power than in other EU countries).	Less power to vice presidents of school buildings, more power to municipality.
BUILDING LOCATION	Urban planning	Location near greenery, in the low polluted area, not busy roads nearby, not near industry sources	Choosing good location for new school buildings: Location near greenery, in the low polluted area, not busy roads nearby, not near industry sources.
		Urban planning implementation of school building based on the bioclimatic approach (sunlight, noise, comfort, IAQ, low level of outdoor air emissions etc.)	Urban planning implementation of school building based on the bioclimatic approach (sunlight, noise, comfort, IAQ, low level of outdoor air emissions etc.)



Topic	Element	Lessons learned from benchmark visits	Proposed action plan
APPROACH / PLANNING PROCESS	Comprehensive approach (planning phase)	Comprehensive approach while designing school building: municipality and government (with professionals: architects, urban planners, CMs, SEs, MEPs, LCFMs, public health experts, economists etc. - interdisciplinary teams), parents, school staff, children.	Comprehensive approach while designing school building
		New concept of designing school buildings: school building is not just a school building but a building combining different functions: community center, youth center, library etc.	New concept of designing school buildings.
		Functional and logical planning of the building.	Functional and logical planning of the building.
	Planning process	Research plan → Investigations → Repair plan/repairs → Follow up	New planning process, for example Research plan → Investigations → Repair plan/repairs → Follow up
	Curriculum	Provided in the national level by governments, in Finland it was changed in 2016, new school curriculum has a huge effect on the design of the building and also planning process (new learning environments); teamwork, »flexible« classrooms, for different users	Change of curriculum (national level).



Topic	Element	Lessons learned from benchmark visits	Proposed action plan
QUALITY OF SCHOOL ENVIRONMENT	Room distribution	Multifunctional areas, transparent, separable inner spaces (using mobile walls, sliding doors) for education and culture to the whole community - all places are »learning spaces« (comprehensive approach: learning, physical activity, life skills); »building serves the user«	Multifunctional spaces, new mobile furniture. <i>*impact more on well-being</i>
		Central dining hall	Meals in one space, not in all classrooms (centralised).
		Integrated inner and outside places for lectures	Integrated inner and outside places for lectures
RENOVATIONS	Insulation	In the same time with thermo- modernisation it is necessary to execute the modernisation of the heating system in combination with the ventilation system	In the same time with thermo- modernisation it is necessary to execute the modernisation of the heating system in combination with the ventilation system
OTHER IMPROVEMENTS	Legislations	Establishing the law regulations - monitoring parameters (CO ₂ , T, RH), regulations for schools (number of pupils in classroom)	Establishing the law regulations - monitoring parameters (CO ₂ , T, RH), regulations for schools (number of pupils in classroom)



D. Acknowledgments

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