# Technical supervision procedures and the quality assurance control plan for three demo sites

# D 3.4

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## Executive summary

The DREEAM approach aims at reaching energy savings of 75% in the building energy consumption: to reach such an ambitious goal it is necessary that the renovation works are performed correctly, therefore the need of a quality assurance system. This work is part of WP3, the demonstration part of the project, and most specifically of Task 3.3 “Technical supervision”, where RISE has the task of developing a plan for quality assurance monitoring during the construction process for each demo site, based on the experience gained within the SQUARE project and on the own systems for moisture-proof, airtight and energy efficient building (ByggaF, ByggaL, ByggaE).

This report is about the quality assurance system (QA) developed by RISE to make sure that the renovation works are done according to best practice in order to reach the ambitious energy efficiency goals set at the beginning of the project. An outline of the QA is provided and documents are provided in appendix.

# Table of contents

# 1 Introduction

An important part of the energy efficiency improvement potential lies in the existing residential building stock. When retrofitting a building many aspects must be taken into account, such as local resources, costs, building traditions, legislation and financing; these aspects have an impact on decision-making and on the outcome of the retrofit, which will differ from case to case, and therefore there are no universal solutions. To achieve the intended results, however, it is required knowledge, continuity and communication. This can be assured by a quality assurance (QA) system that describes a systematic and controlled way of working. A QA system should cover both the retrofitting process and maintenance, since experience shows that a successful energy improvement retrofit will be permanent only if use of the building is guided by effective routines and continuous capacity building of all the parties involved.

## 1.1 Quality assurance in the DREEAM project

In the framework of the DREEAM project it was never the scope though to create a QA system that would encompass the whole project, from the design phase to the operational phase, but only the production process, this due to both time and budget constraints. The QA system developed here is therefore limited to the renovation works. The procedure followed to implement the QA system, for each demo site was:

- Analysis of the renovation measures
- Analysis of the present quality assurance systems and routines, checks during the production phase
- Identification of the work culture at the workplace
- Identification of the critical points during the renovation works
- Creation of a set of checklists and procedures in the specific language
- Submission of the QA system to the project partners
- Site visits and feedback

The original idea was to integrate the QA systems of the building owners to the one developed by RISE: the task was too complex and would have put serious hinders to the timely progression of the renovation works, due to the precedent delays in WP2 and to the fact that it takes a lot of time to introduce change and have it accepted. In the end, it was decided that the experts from RISE would have done the checks onsite by themselves to ensure the good quality of the renovation works: with such a compromise it was possible to avoid bottlenecks in the works progression, which are on time at the time of writing.

## 1.2 Quality assurance in the built environment: ByggaE, ByggaF and ByggaL

The idea of giving RISE the assignment of taking care of the quality system comes from the fact that RISE has successfully developed a QA system, which is currently used in the Swedish market, divided into different modules, each one corresponding to a specific topic of the good building practice:

- ByggaE, for the energetic performance

- ByggaF, for moisture safety
- ByggaL, for air tightness

These systems complete each other and follow the renovation or new building process from the early design stages to the operational phase: they make up, therefore, a complete and reliable QA system that has been already successfully employed in many Swedish projects. The resources are available on line for free, with the aim to make more and more building owners and entrepreneurs following the procedure, to foster good practice and energy efficiency in buildings. They comprise a set of checklists and procedures, completed with a user guide, to give the user insight into the QA process and the reasons why it is implemented.

It should be noted that the working culture in Sweden allows for an extensive use of a checklist-based QA system due to the delegating work culture: the individual worker has a great degree of responsibility and can therefore supervise himself in most of the working situations.

### 1.2.1 The "ByggaX" method

In line with the more stringent requirements on energy efficiency, there is a consequent need for a working method that can, in a structured way, guarantee that the construction of energy efficient buildings is quality assured, so that the goals and requirements set by the building owner are actually reached; this is what ByggaE, F and L are for (the whole of the methods will be referred as ByggaX in short). All the methods have in common the same structure: to reach the set requirements, they focus on the process by clarifying the formulation of requirements and by a constant work to identify and manage critical moments. This is supported by a constant follow-up through the entire process and a clear transfer of information. There is a special focus on the handover between the different stages in the process, as well as on systematic documentation.

The idea behind the method is to give the client support to formulate the requirements on energy efficiency (ByggaE), moisture safety (ByggaF) and air tightness (ByggaL) and to follow them under the course of the project, from planning to finished building. This to ensure that the building will actually meet the requirements set at the beginning. The central part of the method is therefore a systematic work to identify and follow up the critical moments, especially in the production phase, that could make the building risk not to meet the desired requirements. ByggaX provides aid to support the project leader, energy coordinator and contractors in the work to identify and manage the critical moments, also by constant communication.

It is therefore crucial that the building owner appoints a person who takes the responsibility to take care of the energy- and quality assurance work according to ByggaX through the project. The role requires good knowledge of project management and energy in the built environment and can for example be hold by the building owner's project leader or energy coordinator. Some factors as ambition level, complexity, size of the project and its organization influence and guide the choice of the designated person. Even if one of the most important parts of ByggaX is to clarify the roles and responsibilities, it should be noted that it will not work automatically: for the method to work correctly, it is necessary to involve and motivate all the relevant actors in the quality assurance work. For this reason, there is need of a chosen person to carry on, monitor and coordinate the work with the topics indicated within ByggaX.

# 2 Berlin

The renovation measures that will be implemented in Berlin are as follows:

- Creation of new living space in the ground floor of the existing building (800 m²) and a new building with 44 dwellings (3.400 m² living space). The new space in the ground floor is obtained by closing the portico and building a shared apartment for ten elderly people, eight student apartments and new community rooms (minimize heat losses because optimizing outer shell)
- Replacing the disc ventilation in the bathrooms, toilets and kitchens, Renewal of the roof fans and new regulation of the system. Toilets are located in the inner part of the building; the ventilation system is exhaust type.
- Replacement of the old windows with new ones everywhere in the building.
- Asbestos removal in vacant apartments (floor, sewer pipe)
- Installation of new energy-saving lifts with energy recovery and LED lightning
- Photovoltaic system on the roof with an energy storage device (probably 59 kW Peak). Still some debate on how to use the energy produced, in the end it should go for the common areas so that everyone will benefit in the same amount. The electricity generated will be available to all residents for the general electricity supply. In addition, together with Solarimo, electricity will be offered directly to some of the tenants. The electricity price is then at least 15 percent below that of the universal supplier. For the storage of electricity, only one storage for testing purposes will be used. PV systems will probably also be installed on the new building.
- New roof insulation for the photovoltaic system (as it is now the roof does not have sufficient and suitable insulation for the PV system). The previous insulation will be removed.
- Terrace: During the current work, the best way to renovate the terraces is being investigated. This will be implemented next year.

The critical points that were identified whose incorrect execution might affect negatively the energy performance or moisture safety of the building are shown in appendix.

As for the quality system, the construction manager does the checks personally onsite.

# 3 Padiham

The renovation measures that will be implemented in Padiham are as follows:

- External wall insulation with mineral fibre.
- Windows replacement, with an extender frame to facilitate installation of insulation to reveals to avoid thermal bridges.
- Roof and loft insulation. Loft insulation will be 300 mm total thickness, which is 100 mm laid between joists and 200 mm laid perpendicular (on top of that).
- Re-detailing and replacement of the existing roof fascias.
- Boilers upgrade (=replacement of a gas boiler with a new condensation one, or replacement of an electrical boiler with a new one) or replacement (=replacement of an electrical with a gas boiler).
- New mixer showers replacing the old ones to entire bath surround
- Storage heater replacement (hot water cylinder)
- Electrical Radiators replacement (either electric or water depending on the heating systems). Replacement with panel heaters and High Heat Retention Storage Heating, which are units that store heat at night and during off-peak hours when electricity is less expensive. They look like normal radiators.
- New ventilation system (loft mounted supply ventilation unit: it is “positive input” ventilation without heat recovery).
- PV solar panels installation on roof

The critical points that were identified whose incorrect execution might affect negatively the energy performance or moisture safety of the building are shown in appendix.

As for the quality system in the construction phase, PfP has it codified in a booklet (which is a set of checklists and procedures) called “Quality Monitoring Works Inspection”. It is divided in five sections: project inspection action plan, site visits, health and safety audits, quality inspections, post completion review. Every checklist is to be provided by date, address of the site and scope of inspection.

# 4 Treviso

The renovation measures that will be implemented in Treviso are as follows:

- External walls insulation. Panels in polystyrene (16 cm thick)
- Attic and porch slab insulation. The ceiling of the storage rooms and the outside of the porch ceiling will be insulated with 10 cm XPS panels and finished with a plaster board.
- Attic insulation (top floor roof). Insulation of the attic floor with 8 cm XPS finished with concrete.
- Pitched roof insulation. In the cold attic a 20 cm rockwool mattress will be rolled out (two layers, 20 cm is the total thickness).
- Window reveals and radiator niches insulation with Aerogel panels
- Fixtures replacement. All the windows and apartment doors will be replaced. The staircase windows will be double glazed and in PVC, the apartment ones triple glazed, wooden. The doors will be armoured and insulated.
- New insulated aluminium window sills (4 cm XPS)
- Mechanical ventilation. Autonomous units with plug fans and heat recovery for every apartment, placed in the toilet ceiling. Every apartment has its unit and its intake and expulsion channels, located on the balconies. A false ceiling will be built in the toilet and hallway to accommodate for the air ducts. Variable air flow. Intake in the toilets, kitchen and hallway, supply in the other rooms.
- Autonomous boiler replacement. The old boilers will be replaced with new condensation ones: the fuel will still be gas. Installation of thermostatic valves on the radiators (which will not be replaced) as well.
- PV installation on the roof and solar thermal collectors.
- General roof renovation: removal of tiles, elimination of the broken or damaged ones, check of the underlying roof surface, laying of a bitumen layer and positioning again of the roof tiles.

The critical points that were identified whose incorrect execution might affect negatively the energy performance or moisture safety of the building are shown in appendix.

As for the quality system, ATER is certified by ISO 9001 and has therefore specific requirements on the activity flows for the management of the construction phase. The contractor has his own quality management system but the Italian law prohibits any interference from third parts in the contractors' work (to avoid interference from criminal activities). If some modification or intervention in the contractors' QA is desired, then it is necessary to clearly state it in the tendering documents, otherwise it is not possible to do it later.

# 5 The DREEAM quality assurance system

As said in the introduction, due to time constraints, it was decided not to integrate RISE's own tested approach in the QA of every demo site but rather to implement a system of checklists that could be used for every demo site, having the checks performed by RISE's own personnel during the site visits. This was considered to be the best option since doing as it was thought in the DoA would have slowed the process considerably as well as the works, by putting too much pressure on the building owners and the whole project would have incurred in further delays.

It should be kept in mind that for a complete quality system to be applicable to, and effective for, a specific project, it needs to be customised to the particular procedures and activities of the organisation concerned. In concrete terms, this means that the organisation must, either by means of its own efforts or by bringing in an external consultant, construct the quality assurance system, draw up the necessary procedures and documents, and anchor the system in the organisation. This was outside the scope of the work but shows the concept behind how comprehensive quality assurance is in general.

The building owners have the possibility, if interested on the approach provided in the project framework, to discuss with RISE about further implications of its implementation in their own QA.

## 5.1 Structure and concept

The QA developed by RISE for the DREEAM project stems from the above cited ByggaE, L and F systems. Since ByggaX is conceived for the whole renovation (or new construction) process, it was necessary to reduce its scope to just the production process and to cut the accessory activities, since it was decided that RISE would do the checks itself and then report on both with the building owners in case deviations were observed, and in the relevant deliverables about the site supervision visits.

The documents that were implemented in the DREEAM QA system for production are listed and explained briefly here, and can be found in the deliverable appendix.

It should be noted that there are also a few documents that do not belong strictly to the production phase, but rather to the previous project- and tendering phases. These were included to make the QA more understandable to the project partners and to underline the importance of a comprehensive approach, from the early project stages to the management of the finished building. The work done in one phase will influence what happens downstream; having quality assurance in every stage of the project ensures that the goals set by the client will be met.

Since RISE followed the tendering process for the demo sites, it was thought to be relevant to include in the quality assurance the procedure for the handover to production. The building owners in the project are already following a routine for establishing the requirements on the workplace, skills, documentation and so on, but it was thought to be interesting to see it from a different point of view and a differently structured way.

### 5.1.1 Energy performance summary

**Purpose of the document:** To summarize important data about the energy performance of the building. The aim is to make possible to follow in a clear way how the expected energy performance and other fundamental inputs change during the whole process, from the early planning to the finished building.

**Instructions to the document:** Every phase has its own column; the first ones are for the external requirements such as national and local laws such as the municipality's planning. The first row is to specify which kind of requirement is taken into account, such as Miljöbyggnad Silver and so on. On the same row it is also possible to rename the phases according to how they are actually called in the project, which can be changed during the project itself if needed. It is possible to add/remove rows and columns to tailor the document to one's convenience. This document is to be updated throughout the course of the project.

**Who should use the document:**

- **Who prepares the document?** Building owner, project team, contractors. The energy coordinator asks to the relevant actors about the necessary info.
- **Who fills in the document?** The energy coordinator if there is one, otherwise the project leader.
- **Who reads the document?** Building owner, contractor, etc.
- **Who for further info?** The document can be used as support for the project leader or building owner to be able to explain the results of the project to, for example, politicians in the local community, financiers, buyers and so on

### 5.1.2 Measurement schedule for follow-up – building owner's requirements

**Purpose of the document:** to summarise the requirements and check them with measurements and controls.

**Instructions to the document:** Fill in the tables, adjusting the columns if needed. The document includes verifications of different types such as calculations, control of documents, visual checks, measurements and so on. The document is to be completed with information from the planning phase such as by transferring info on the follow-up requirements that were identified in the checklist for the planning phase. The plan will be later updated by the contractor (see 5.1.5).

**Who should use the document:** It is set up by the building owner together with the energy coordinator.

### 5.1.3 Checklist for tendering – handover to production

**Purpose of the document:** to ensure that the tendering documents meet the requirements and that the evaluation template and requirements in the tendering phase itself are correct.

**Instructions to the document:** the process is divided into steps. Publication of the tender, evaluation of the offers, review before the contract and information transfer (those steps can vary depending on the type of the contractor's firm). The first thing to be done is to tailor those steps to the tendering form, by adapting the columns to the specific needs. Go through the tendering documents to make sure that the critical control points are addressed at the right time.

**Who should use the document:** building owner or his/her project leader, energy coordinator.

### 5.1.4 Checklists for energy efficient production (Construction, HVAC, electrical and control systems)

**Purpose of the document:** Every part the document is divided into is meant for the relevant contractor/installer (construction, HVAC, electricity and control)

**Instructions to the document:** In the checklists there is advice on the moments and things that are important to take care of during the production phase so that the building will actually become energy efficient. This advice is in form of a bullet point list in the colum "To take into account". When the point is considered, the box is ticked and a solution or an explanation is written in the reporting column. It is also possible to refer to some other document where the description is reported, such as documents from the project phase. It is recommended to always add a short summary in this checklist. Sometimes it is needed to follow up the result of the measure that is to be taken, through for example a measurement or a check. This is reported in the dedicated column on the right "Follow up".

**Who should use the document:** Contractor, energy coordinator

### 5.1.5 Measurements schedule for follow-up

**Purpose of the document:** to summarise the requirements and check them with measurements and controls.

**Instructions to the document:** Fill in the tables, adjusting the columns if needed. The document includes verifications of different types such as calculations, control of documents, visual checks, measurements and so on. The document is to be completed with information from the production phase such as by transferring info on the follow-up requirements that were identified in the checklist for the production phase. It stems from the data included in the control plan made in the phase prior to production.

**Who should use the document:** It is set up by the responsible planner together with the energy coordinator.

### 5.1.6 Agenda for energy coordination meetings

**Purpose of the document:** to gather minutes from the energy coordination meetings and organize them around important questions. The document is to be put in a folder that will collect all the meeting minutes.

**Instructions to the document:** in the template there are suggestions about questions that should be discussed during a meeting about energy performance. This kind of "energy-themed" meetings could happen on a separate occasion than ordinary project meetings, or the questions could just be added to the agenda of the normal meeting.

**Who should use the document:** meeting responsible, such as energy coordinator or project manager. They will leave the document and the minutes in the folder for the other colleagues and partners to read.

### 5.1.7 Energy inspection round

**Purpose of the document:** to list the building owners' controls during the production phase to assure the quality. The energy check routine does not replace the quality assurance work of the contractor.

**Instructions to the document:** tailor the routine to the project before filling it in.

**Who should use the document:** client's energy expert.

### 5.1.8 Moisture inspection round

**Purpose of the document:** to list the building owners' controls for moisture safe construction during the production phase to assure quality. The moisture check routine does not replace the quality assurance work on moisture safety of the contractor. This inspection round can be performed in conjunction with other inspection rounds.

**Instructions to the document:** tailor the routine to the project before filling it in.

**Who should use the document:** client's moisture expert.

### 5.1.9 Checklist for airtight production

**Purpose of the document:** to list the building owners' controls for air tight construction during the production phase to assure quality. The air tightness checklist does not replace the quality assurance work on air tightness of the contractor.

**Instructions to the document:** tailor the routine to the project before filling it in.

**Who should use the document:** client's energy expert.

### 5.1.10 Deviation reports

**Purpose of the document:** to report and document any deviation from the energy requirements description and energy plan for production.

**Instructions to the document:** fill in the document. Tailor the report template to the project's needs if required.

**Who should use the document:** energy coordinator, project leader, contractor or anyone involved with the controls.

# 6 Conclusion

This deliverable was to outline the quality assurance system developed by RISE, based on its own quality systems: the method was outlined and material provided in the appendix in form of checklists and essential documents. As it was pointed out, it was decided, together with the project management and building owners, not to implement the quality system into their own and entrepreneurs' routines since it would have further delayed the works and the effort would not have been justified by the benefits, due to the limited scope of a QA just for the production phase. It was therefore decided that RISE's personnel would do the quality assurance checks during the site visits, to make sure that the renovation works are performed in a way to reach the ambitious project goals, which are dependent on the correct implementation of the renovation solutions.

RISE is at disposal of the building owners to provide assistance and the necessary knowledge in case they would be interested in applying the aforementioned QA for the whole project course (checklists, procedures and routines from the early stages to management) in their own systems and routines for a long-term structural change, but it is by no means mandatory.

# 7 Appendix

## 7.1 Critical points identified for the production phase for the site in Berlin

**Renewal of façade sealing:**

- Calculate the small dilatations/contractions that might occur in the façade boards due to temperature and humidity to correctly dimension the new joints
- Have the concrete surface where the sealant will be installed level and free from superficial pores, to guarantee good adhesion and therefore waterproofing
- Use the right sealant for the specific application

**Windows replacement:**

- Install windows that have the desired properties (U-value, soundproofing and so on) certified
- Make sure that the sill on the internal side does not obstacle the warm airflow from the underlying radiator (to prevent condensation and cold drafts)
- Place the window close to the inside of the wall
- Make sure that there is proper sealing between the window frame and sash
- When installing the windows, apply a two-steps approach for waterproofing the joints, which means to separate the rain protection to the wind protection function: the first part of the seal has just the aim of preventing the raindrops for directly getting in)

**Roof:**

- When renovating the waterproofing, avoid direct installation of the bitumen layer on cellular plastic, both due to the risk of burning when applying the bitumen and also because cellular plastic shrinks under the influence of the sun, which will turn into leaks between the insulation boards and therefore heat losses. It is recommended to place at least 20mm of mineral wool on top of the insulation to protect it.
- Use a vapour barrier to prevent moisture from going upwards
- Moisture safety of the roof depends mostly on additional components such as gutters, vents, flashings and how the waterproofing is sealed around those components. Make sure that the perforations are sealed appropriately
- Solar panels installation to ensure that the fastenings are correctly dimensioned to withstand wind loads and that they will not impact on the weatherproofing of the roof

**Terrace roof:**

- Make sure that any surface treatment on the other side of the slab is more permeable to vapour than the vapour barrier.
- Keep the isolation material safe from moisture and damage during the installation phase
- Bring the waterproofing layer high enough at the terrace borders, and protect it from damage under construction.

- Check the effectiveness of the drainage system at the windows base: it is usually not optimal to have the terrace at the same level as the apartment floor or above as it will facilitate inwards leakage.

## 7.2 Critical points identified for the production phase for the site in Padiham

External wall insulation:

- When the finish is applied directly on the insulation (on mortar), then it has to give adequate protection against driving rain. It has been proved that building a completely rainproof rendered façade it is almost impossible: some water during hard rainfall could get in through possible cracks or connections. Since there is no ventilated air gap behind the render, it will take some time for the water to dry. The PermaRock system has good permeability which should allow drying; anyway it should be verified through calculations that the critical values of relative humidity for the wall materials are not exceeded
- Every perforation through the insulation layer has to be sealed correctly to avoid thermal bridging and moisture penetration (condensate pipe, overflow outlet, waste water outlet, ventilation ducts, gas meter box and so on)
- Provide adequate protection to the external insulation where the roof overhang is not sufficient to cover the new insulation layer, as indicated in the specs

Windows replacement:

- Install windows that have the desired properties (U-value, soundproofing and so on) certified
- Make sure that the sill on the internal side does not obstacle the warm airflow from the underlying radiator (to prevent condensation and cold drafts)
- Place the window close to the inside of the wall
- Make sure that there is proper sealing between the window frame and sash
- When installing the windows, apply a two-steps approach for waterproofing the joints, which means to separate the rain protection to the wind protection function: the first part of the seal has just the aim of preventing the raindrops for directly getting in)
- Careful sealing of the extender frame

Roof/attic insulation

- When applying internal insulation to the inside of the roof (i.e. between the joists), consider the application of a vapour membrane, especially if the vapour permeability of the roof is not known
- Check with calculations the relative humidity values that might occur at the joists and make sure that they will not exceed the critical threshold of 75% (or less if a safety factor is desired)
- Make sure that the new insulation does not block the ventilation intakes at the attic
- Make the attic slab as airtight as possible when insulating it to prevent warm moist air from the lower floors to get into the cold attic and condensate.

## 7.3 Critical points identified for the production phase for the site in Treviso

External wall insulation:

- Restore accurately the plaster of the external wall where damaged, to allow for correct installation of the external insulation
- When the finish is applied directly on the insulation (on mortar), then it has to give adequate protection against driving rain. It has been proved that building a completely rainproof rendered façade it is almost impossible: some water during hard rainfall could get in through possible cracks or connections. Since there is no ventilated air gap behind the render, it will take some time for the water to dry. The PermaRock system has good permeability which should allow drying; anyway it should be verified through calculations that the critical values of relative humidity for the wall materials are not exceeded
- Every perforation through the insulation layer has to be sealed correctly to avoid thermal bridging and moisture penetration (condensate pipe, overflow outlet, waste water outlet, ventilation ducts)
- Install the aerogel panels in the window reveals by paying attention to the joining and sealing to avoid thermal bridging

Windows replacement:

- Install windows that have the desired properties (U-value, soundproofing and so on) certified
- Make sure that the sill on the internal side does not obstacle the warm airflow from the underlying radiator (to prevent condensation and cold drafts)
- Place the window close to the inside of the wall
- Make sure that there is proper sealing between the window frame and sash
- When installing the windows, apply a two-steps approach for waterproofing the joints, which means to separate the rain protection to the wind protection function: the first part of the seal has just the aim of preventing the raindrops for directly getting in)
- When installing the new insulated aluminium window sill, pay attention to correct sealing to ensure water- and airtightness.

Roof/attic insulation

- Avoid thermal bridging when insulating the cold roof slab, adjust insulation thickness to provide uniform U-value
- Make the attic slab as airtight as possible when insulating it to prevent warm moist air from the lower floors from getting into the common room

# Energy performance summary



Project:
Responisble:
Latest modified:

Approved by:

……
Date Signature

| Phase: | Law requirement | Municipality or other local requirements | Requirements according chosen method | Planning/client requirements | Handover to planning stage | Planning | Handover to construction stage | Production | Handover to final controls/management | Warranty-management | Management |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Specification of requirements/Project custom name of phase** | | | | | | | | | | | |
| **System/part:** | | | | | | | | | | | |
| **GENERAL** | | | | | | | | | | | |
| Total energy use (kWh/year) | | | | | | | | | | | |
| Specific energy use (kWh/m², year) | | | | | | | | | | | |
| Operational/ Household energy (kWh/m²,year) | | | | | | | | | | | |
| Hot water (kWh/m²,year) | | | | | | | | | | | |
| Locally produced energy (kWh/m²,year) | | | | | | | | | | | |
| Total net energy consumption (bought energy) (kWh/m²,year) | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |

# Energy performance summary



Project:
Responisble:
Latest modified:

Approved by:

……
Date Signature

| Phase: | Law requirement | Municipality or other local requirements | Requirements according chosen method | Planning/client requirements | Handover to planning stage | Planning | Handover to construction stage | Production | Handover to final controls/management | Warranty-management | Management |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Specification of requirements/Project custom name of phase** | | | | | | | | | | | |
| **INDOOR ENVIRONMENT**<br>*Think that the different requirements can be given for presence/absence* | | | | | | | | | | | |
| Thermal comfort<br><br>*Here are reported the project requirements for thermal climate, such as air temperature, operative temperature and floor temperature* | | | | | | | | | | | |
| Ventilation, air changes (l/s,m$^{2)}$ | | | | | | | | | | | |
| Noise from installations | | | | | | | | | | | |
| Moisture | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |
| **BUILDING ENVELOPE** | | | | | | | | | | | |
| Um (entire building) (W/m$^2$,K) | | | | | | | | | | | |

# Energy performance summary



Project:
Responisble:
Latest modified:

Approved by:

……
Date Signature

| Phase: | Law requirement | Municipality or other local requirements | Requirements according chosen method | Planning/client requirements | Handover to planning stage | Planning | Handover to construction stage | Production | Handover to final controls/management | Warranty-management | Management |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Specification of requirements/Project custom name of phase** | | | | | | | | | | | |
| Windows, U ($W/m^2,K$) | | | | | | | | | | | |
| Doors, U ($W/m^2,K$) | | | | | | | | | | | |
| Air tightness building envelope ($l/sm^2$) | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |
| **BUILDING SYSTEMS**[1] | | | | | | | | | | | |
| **Heating** | | | | | | | | | | | |
| Type of heat source | | | | | | | | | | | |
| Type of heat distribution | | | | | | | | | | | |
| Pump motor efficiency (%) | | | | | | | | | | | |

[1] Complete with more lines if there are more systems and units

# Energy performance summary



Project:
Responisble:
Latest modified:

Approved by:

……
Date Signature

| Phase: | Law requirement | Municipality or other local requirements | Requirements according chosen method | Planning/client requirements | Handover to planning stage | Planning | Handover to construction stage | Production | Handover to final controls/management | Warranty-management | Management |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Specification of requirements/Project custom name of phase** | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |
| **Cooling** | | | | | | | | | | | |
| Type of source | | | | | | | | | | | |
| Type of distribution system (es. Cooling beams) | | | | | | | | | | | |
| Pumps motor efficiency (%) | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |
| **Hot water** | | | | | | | | | | | |
| Type of source | | | | | | | | | | | |
| Circulation losses | | | | | | | | | | | |
| Conversion losses | | | | | | | | | | | |

# Energy performance summary



Project:
Responisble:
Latest modified:

Approved by:

……
Date Signature

| Phase: | Law requirement | Municipality or other local requirements | Requirements according chosen method | Planning/client requirements | Handover to planning stage | Planning | Handover to construction stage | Production | Handover to final controls/management | Warranty-management | Management |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Specification of requirements/Project custom name of phase** | | | | | | | | | | | |
| Pumps motor efficiency (%) | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |
| **Ventilation** | | | | | | | | | | | |
| Type of flow, constant or variable | | | | | | | | | | | |
| Type of heat recovery | | | | | | | | | | | |
| Efficiency (%) | | | | | | | | | | | |
| SFP | | | | | | | | | | | |
| Motor efficiency (%) | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |
| **Electrical systems** | | | | | | | | | | | |

# Energy performance summary



Project:
Responisble:
Latest modified:

Approved by:

……
Date Signature

| Phase: | Law requirement | Municipality or other local requirements | Requirements according chosen method | Planning/client requirements | Handover to planning stage | Planning | Handover to construction stage | Production | Handover to final controls/management | Warranty-management | Management |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Specification of requirements/Project custom name of phase** | | | | | | | | | | | |
| Cable losses | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |
| **Lighting** | | | | | | | | | | | |
| Lighting control | | | | | | | | | | | |
| Lighting requirements | | | | | | | | | | | |
| Installed effect ($W/m^2$) | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |
| **Control, routines and measurements** | | | | | | | | | | | |
| Demand control | | | | | | | | | | | |
| Measurement and follow-up | | | | | | | | | | | |

# Energy performance summary



Project:
Responisble:
Latest modified:

Approved by:

……
Date Signature

| Phase: | Law requirement | Municipality or other local requirements | Requirements according chosen method | Planning/client requirements | Handover to planning stage | Planning | Handover to construction stage | Production | Handover to final controls/management | Warranty-management | Management |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Specification of requirements/Project custom name of phase** | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |
| **Operation /household energy** | | | | | | | | | | | |
| Specific equipment (Indicate which, complete with more lines) | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |
| **Economics** | | | | | | | | | | | |

# Energy performance summary



Project:
Responisble:
Latest modified:

Approved by:

……
Date Signature

| Phase: | Law requirement | Municipality or other local requirements | Requirements according chosen method | Planning/client requirements | Handover to planning stage | Planning | Handover to construction stage | Production | Handover to final controls/management | Warranty-management | Management |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Specification of requirements/Project custom name of phase** | | | | | | | | | | | |
| Economic parameters for calculations, such as interest rate, depreciation times, energy prices etc. | | | | | | | | | | | |
| *Complete with further requirements (if any)* | | | | | | | | | | | |

Add more lines if there are more requirements for different building or system parts, alternatively refer to other documents.

Project:

Approved by:
Responisble:

Latest
modified:

……

Date Signature

# Plan for follow up – builder's requirement

## Instructions

The purpose of this document is to summarize the requirements that the builder asks for within the quality assurance of the building process. It concerns different checks such as calculations, control of documentation, visual checks, measurements etc. including possible requirements on personnel skills. This document is a complement to the description of energy requirements.

Fill the table below for the respective verification requirements (an example is given).

| Building/ area | Functional requirement | Type of verification plus any skill requirements and time plan | Reporting | Responsible | Done | Result |
|---|---|---|---|---|---|---|
| *House A* | *Air tightness* | *Measurement according to EN 13829 in the finished building.*<br><br>*Moreover, search for air leaks before the construction works are done.* | *Written report* | *Contractor* | *Date/sign* | *OK, possible ref. to result* |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

# Checklist for tendering – handover to production 

Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| | Charecteristic | ▪ To take into account:<br>▪ Exemples on critical points/requirements<br>A ticked square means that the point has been taken into account | Result<br>**Reporting:**<br>Comments (motivation) to requirement/control point/result.<br>Reference to document |
|---|---|---|---|
| Tendering | Functional requirements | ☐ It was checked that the technical functional requirements were included in the tendering document. | Comments:<br>Reference: |
| | Skill requirements<br>Requirements on: | ☐ Organisation<br>☐ Training/competence (for instance certified passive house builder, energy expert, certified moisture expert, installator etc.)<br>☐ Experience/reference persons<br>☐ Reference objects | Comments:<br>Reference: |
| | Quality assurance<br>Requirements on: | ☐ Quality management system<br>☐ Environmental management system<br>☐ Quality and environmental plan<br>☐ Own controls<br>☐ Control procedure<br>☐ Measurements and controls for verification<br>☐ Planning and organisation of work<br>☐ Management of deviations | Comments:<br>Reference: |
| | Documentation<br>Requirements on: | ☐ Presentation of offer<br>☐ Presentation of materials and performance of components<br>☐ Additional documentation<br>☐ Presentation of own controls<br>☐ Presentation of simulations (as drying of moisture)<br>☐ Presentation of meetings (as meeting protocols) | Comments:<br>Reference: |

# Checklist for tendering – handover to production 30 (5)

Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| | Charecteristic | ▪ To take into account:<br>▪ Exemples on critical points/requirements<br>A ticked square means that the point has been taken into account | Result<br>**Reporting:**<br>Comments (motivation) to requirement/control point/result.<br>Reference to document |
|---|---|---|---|
| | Management of information<br>Requirements on: | ☐ Project database<br>☐ Mandatory meetings/activities<br>☐ Information/education of users and maintenance personnel | Comments:<br>Reference: |
| | Workplace<br>Requirements on: | ☐ Energy efficient establishment<br>☐ Energy for heating and drying (construction and storehouses)<br>☐ Weather protection (construction and material storage) | Comments:<br>Reference: |
| | Other requirements, specific for this project | ☐ ……<br>☐ …….. | Comments:<br>Reference: |
| Evaluation of offer | Evaluation method | ☐ Ensure that the method to evaluate the offer takes into account energy aspects. Check that those requirements are also in the offer evaluation template. | Comments:<br>Reference: |
| | Documentation | ☐ The evaluation of the offer is documented. State where the documentation is available. | Comments:<br>Reference: |

# Checklist for tendering – handover to production 

Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| | Charecteristic | ▪ To take into account:<br>▪ Exemples on critical points/requirements<br>A ticked square means that the point has been taken into account | Result<br>**Reporting:**<br>Comments (motivation) to requirement/control point/result.<br>Reference to document |
|---|---|---|---|
| Review before writing the contract | Requirements on competence | ☐ Presentation of the contractor's organisation, competence and reference objects | Comments:<br>Reference: |
| | Responsibility | ☐ Review of responsibilities | Comments:<br>Reference: |
| | Requirements | ☐ Review of the requirements to make sure that the contractor has understood them correctly | Comments:<br>Reference: |
| | Competence/equipment | ☐ The contractor has shown a method for calculations, measurements and checks. | Comments:<br>Reference: |
| | Quality assurance, verification | Review of the quality assurance measures. Report/agree about requirements on validation in form of:<br>☐ Inspection of documentation before releasing it<br>☐ Inspection of coordination plan<br>☐ Calculations<br>☐ Measurements<br>☐ Checks | Comments:<br>Reference: |

# Checklist for tendering – handover to production 32 (5)

Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| | Charecteristic | ▪ To take into account:<br>▪ Exemples on critical points/requirements<br>A ticked square means that the point has been taken into account | Result<br>**Reporting:**<br>Comments (motivation) to requirement/control point/result.<br>Reference to document |
|---|---|---|---|
| | Management of deviations | ☐ Review of deviations reporting | Comments:<br>Reference: |
| | Spreading of information and communication | ☐ Review of how the spreading of information within the organisation is ensured<br>☐ Review of how the spreading of information to the construction phase is ensured | Comments:<br>Reference: |
| | Lessons learned | ☐ Report how the lessons learned and experience gained at the end of the project will be done | Comments:<br>Reference: |
| **Information transfer** | 2.1.1 Energy requirements<br>2.2.2 Measurement plan for follow up – builder's requirement | ☐ Review with project group<br>☐ Routine for introduction of the energy requirements for future workers | |
| | Functional requirements | ☐ Review of specific functional requirements for the project | |
| | Competence | ☐ Establish a training plan for project workers to ensure that there is the right competence | |
| | Quality assurance | ☐ Review of quality assurance routines | |

# Checklist for tendering – handover to production 

Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| | Charecteristic | ▪ To take into account:<br>▪ Exemples on critical points/requirements<br>A ticked square means that the point has been taken into account | Result<br>**Reporting:**<br>Comments (motivation) to requirement/control point/result.<br>Reference to document |
|---|---|---|---|
| | Information management | ☐ Establishment of routines for information management in the project group<br>☐ Plan for energy simulations | |
| | Other requirements | ☐ Review of management plan for deviations | |

Checklist goal:
Builder's checklist to guarantee the tendering and transfer to the production phase.
Tendering: give examples on which points in the tendering documents it is important to have requirements and then check during the tendering phase
Handover; give examples on requirements/checkpoints, such as activities, documentation and so on which will make the handover safe.

# Construction - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | Properties: | To take into account:<br>Exemples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result<br>Comments:<br>Comments to performed controls<br>Refer to documents where results, assessments etc. are presented. Is more follow-up needed? | Checked?<br>Sign the check |
|---|---|---|---|---|
| Ground | Insulation | ☐ Filling (light sheets are cut with an excess of 5-10 mm for good filling)<br>☐ Width of insulation suited for wooden or steel studs<br>☐ Joints<br>☐ Correct density<br>☐ Termography | Comments:<br>Reference: | ☐ Yes ☐ No<br>Signature<br>Company |
| | | ☐ Thermal bridges, execution:<br>• Joints in the insulation material<br>• Perforations<br>• Floor slabs<br>• Edge beam<br>• Culvert<br>• Crawlspace door<br>• Filling of insulation material (compare mineral wool - cellular plastic) | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | | ☐ Installation of windbreak, joints, connections and perforations. | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |

# Construction - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | Properties: | To take into account:<br><br>Exemples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result<br>Comments:<br>Comments to performed controls<br>Refer to documents where results, assessments etc. are presented. Is more follow-up needed? | Checked?<br>Sign the check |
|---|---|---|---|---|
| | Air tightness | ☐ Perforations<br>☐ Multiple perforations (it could be difficult to make it airtight, a fixing plate might be necessary)<br>☐ Cast joints<br>☐ Edge elements<br>☐ Level differences with the floor<br>☐ Floor angle, connection to sleepers | Comments:<br><br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Moisture | ☐ Construction moisture<br>☐ Ground moisture, large concrete slabs<br>☐ Capillar break layer to prevent water from reaching the insulation | Comments:<br><br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Other | ☐ Radon<br>☐ Insulation of installations in the ground construction<br>☐ Floor heating<br>☐ Robustness<br>☐ Sensible moments identified<br>☐ Design solutions checked | Comments:<br><br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |

# Construction - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | Properties: | To take into account:<br>Exemples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result<br>Comments:<br>Comments to performed controls<br>Refer to documents where results, assessments etc. are presented. Is more follow-up needed? | Checked?<br>Sign the check |
|---|---|---|---|---|
| External wall | Insulation | ☐ Filling (light sheets are cut with an excess of 5-10 mm for good filling)<br>☐ Width of bought insulation suited for wooden or steel studs<br>☐ Joints<br>☐ Correct density<br>☐ Correct installation, fiber orientation<br>☐ Termography | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | | ☐ Thermal bridges:<br>• Windows installation<br>• Doors installation<br>• Perforations<br>• Bearing frame<br>• Floor slab connections with walls<br>• Balconies fastening<br>• Shaft<br>• Sheets in the construction<br>• Filling of insulation material (compare mineral wool - cellular plastic) | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | | ☐ Installation of windbreak, joints, connections and perforations. Pay attention also to water diversion function.<br>☐ Risk for water permanence and its influence on the insulation properties<br>☐ Natural convection | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |

# Construction - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | Properties: | To take into account:<br><br>Exemples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result | |
|---|---|---|---|---|
| | | | **Comments:**<br>Comments to performed controls<br>Refer to documents where results, assessments etc. are presented. Is more follow-up needed? | **Checked?**<br>Sign the check |
| | Air tightness | ☐ Connections<br>☐ Joints<br>☐ Perforations | Comments:<br><br>Reference: | ☐ Yes ☐ No<br>What?<br><br>When? |
| | Moisture | ☐ Construction moisture<br>☐ Diffusion (placement of vapour barrier)<br>☐ Convection | Comments:<br><br>Reference: | ☐ Yes ☐ No<br>What?<br><br>When? |
| | Other | ☐ Insulation of installations<br>☐ Robustness<br>☐ Risk for errors | Comments:<br><br>Reference: | ☐ Yes ☐ No<br>What?<br><br>When? |

# Construction - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | Properties: | To take into account:<br>Exemples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result<br>Comments:<br>Comments to performed controls<br>Refer to documents where results, assessments etc. are presented. Is more follow-up needed? | Checked?<br>Sign the check |
|---|---|---|---|---|
| Roof, attic | Insulation | ☐ Filling (light sheets are cut with an excess of 5-10 mm for good filling)<br>☐ Width of bought insulation suited for wooden or steel studs<br>☐ Joints<br>☐ Correct density<br>☐ Correct installation, fiber orientation<br>☐ Termography | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | | ☐ Thermal bridges:<br>• Perforations<br>• Bearing frame<br>• Floor slab connections with external walls<br>• Sheets in the construction<br>• Filling of insulation material (compare mineral wool - cellular plastic) | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | | ☐ Wind break, risk for wind blowing into the insulation | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | | ☐ Risk for water permanence and its influence on the insulation properties | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |

# Construction - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | Properties: | To take into account:<br>Exemples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result<br>Comments:<br>Comments to performed controls<br>Refer to documents where results, assessments etc. are presented. Is more follow-up needed? | Checked?<br>Sign the check |
|---|---|---|---|---|
| | | ☐ Natural convection | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Air tightness | ☐ Connections<br>☐ Joints<br>☐ Multiple perforations (it could be difficult to make it airtight, a fixing plate might be necessary)<br>☐ Trapdoor to attic<br>☐ Early air tightness test | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Moisture | ☐ Construction moisture<br>☐ Diffusion (placement of vapour barrier)<br>☐ Convection<br>☐ Night radiation towards sky | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Other | ☐ Insulation of installations<br>☐ Robustness<br>☐ Risk for errors | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |

Reference and tools:

- Calculation softwares
- prEN ISO 13789

# Construction - Checklist for production

Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

- SS-EN ISO 13370
- Heat 2+3
- ParaSol (www.ebd.lth.se)
- ByggaL
- ByggaF

# Heat - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | System part: | Operation time: Fill in | To take into account: Exemples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result<br>**Reporting:** Comments to chosen solution. Refer to documents where the result, assessment etc. are presented. | **Follow-up required?** If follow-up is required, state what it is necessary and when should it take place. |
|---|---|---|---|---|---|
| Heating system | Radiators | In case of heating demand | ☐ Is the right radiator at the right place, according to the drawings?<br>☐ Check of the control function, thermostat or thermostatic valves<br>☐ Positioning of the sensor for the thermostatic valves<br>☐ Pressure drop<br>☐ Combined control with room cooling | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Ventilation | In case of heating demand in the supply air | ☐ System temperatures<br>☐ Type of pipe coupling<br>☐ System control | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Golvvärme | In case of heating demand in the room | ☐ System temperatures<br>☐ Control, room thermostat, electronic control<br>☐ Heat demand of the room, fast changes or stable level | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |

# Heat - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | System part: | Operation time: Fill in | To take into account: Exemples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result<br>**Reporting:** Comments to chosen solution. Refer to documents where the result, assessment etc. are presented. | **Follow-up required?** If follow-up is required, state what it is necessary and when should it take place. |
|---|---|---|---|---|---|
| | Piping system | | ☐ System temperatures<br>☐ Pressure setup<br>☐ Adjustment<br>☐ Cleaning, venting<br>☐ Insulation, calculate energy loss and temperatured drop for the ducts | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Pumps | | ☐ Control of flow, pressure, timer<br>☐ Motor efficiency | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Filter | | ☐ Pressure loss | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Balancing valves | | ☐ Are they balanced? | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| General | Energy requirements description, including Measurement plan for follow up – builder's requirement | | ☐ Requirements according to the energy requirements description which is valid for the production phase. | | |

# V – Ventilation - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | System part: | Operation time: Fill in | To take into account: Exemples on critical points, important moments etc A ticked square means that the point has been taken into account | Result | |
|---|---|---|---|---|---|
| | | | | **Reporting:** Comments to chosen solution. Refer to documents where the result, assessment etc.are presented. | **Follow-up needed?** If follow-up is needed, write down what needs to be followed up and when. |
| General | System conditions | | ☐ Installation, coupling and control of sectioning damper according to construction documents. Check of function and system control.<br>☐ Setup of operation times according to construction documents. Check with client, user.<br>☐ Electrical efficiency. Does it comply with the requirement on SFP-value?<br>☐ Check of coupling so that the cooperation between ventilation and the other systems is correct, such as with heating and cooling systems.<br>☐ Space requirements for servicing of the ventilation system: change of filters, cleaning etc. | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Fans | If ventilation is needed | ☐ Control of airflow, pressure, time schedule<br>☐ Capacity in relation to need<br>☐ Efficiency in different operating modes<br>☐ Placement in the system/system efficiency<br>☐ Heat delivery<br>☐ Noise properties | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |

# V – Ventilation - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | System part: | Operation time: Fill in | To take into account: Exemples on critical points, important moments etc A ticked square means that the point has been taken into account | Result | |
|---|---|---|---|---|---|
| | | | | **Reporting:** Comments to chosen solution. Refer to documents where the result, assessment etc.are presented. | **Follow-up needed?** If follow-up is needed, write down what needs to be followed up and when. |
| | Duct system | | ☐ Pressure loss as a function of airflow<br>☐ Tightness class (B, C or D)<br>☐ Pressure class (1, 2 or 3)<br>☐ Insulation against heat and cool losses<br>☐ Avoid unnecessary bends and so on that influence the pressure loss | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Noise damper | | ☐ Noise attenuation<br>☐ Pressure loss as a function of airflow | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Air filter | | ☐ Which filter class is required: F5, F6, F7…<br>☐ Coal filter or some other cleaning required?<br>☐ Routine for filter change<br>☐ Pressure loss as a function of airflow<br>☐ LCA | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Air intake and exhaust outlet | | ☐ Pressure loss as a function of airflow<br>☐ Air quality at intake<br>☐ Risk of short circuiting (exhaust to intake)<br>☐ Temperature influence from the surroundings<br>☐ Ducting for fresh and exhaust air, take into account the temperature of fresh air and the temperature influence of the building | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |

# V – Ventilation - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | System part: | Operation time: Fill in | To take into account: Exemples on critical points, important moments etc A ticked square means that the point has been taken into account | Result | |
|---|---|---|---|---|---|
| | | | | **Reporting:** Comments to chosen solution. Refer to documents where the result, assessment etc.are presented. | **Follow-up needed?** If follow-up is needed, write down what needs to be followed up and when. |
| | Heat recovery | If ventilation is needed | ☐ Heat recovery, setting of parameters, check for instance that the cooling does not cool when recovering the heat<br>☐ Airflow and flow balance<br>☐ Pressure loss as a function of airflow<br>☐ Possible need for defrost/condensate discharge<br>☐ Could the outside air be pre-heated through the ground?<br>☐ Temperature and system efficiency<br>☐ Control through by-pass or slowing down<br>☐ Possible control of humidification<br>☐ Pressure conditions at the heat exchanger<br>☐ Risk for transfer of contaminants to supply | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Damper for adjustment | | ☐ Capacity: pressure loss - flow<br>☐ Noise properties | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Energy requirements description, including Measurement plan for follow up – builder's requirement | | ☐ Requirements according to the energy requirements description which is valid for the production phase. | | |

# V – Ventilation - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | System part: | Operation time:<br>Fill in | To take into account:<br>Exemples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result<br>Reporting:<br>Comments to chosen solution. Refer to documents where the result, assessment etc.are presented. | Follow-up needed?<br>If follow-up is needed, write down what needs to be followed up and when. |
|---|---|---|---|---|---|
| Property | Ventilation batteries (coils) | When cooling/heating the supply air | ☐ System temperatures, dimension the batteries according to the system requisites<br>☐ Decrease the dehumidification, if it is not needed to satisfy the requirements and minimise the risks for condensation for example on the baffles in the building<br>☐ Pressure loss as a function of airflow | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| Office and conference room | Supply and exhaust air diffuser | If ventilation is needed | ☐ Airflow needed when occupied/unoccupied<br>☐ Control: presence, CO2 and temperature<br>☐ Noise generation - attenuation<br>☐ Supply air method (displacement/mixing)<br>☐ Capacity: pressure loss - airflow<br>☐ Thermal comfort (temp, air speed)<br>☐ Incorporated with the local cooling system | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| Residential-room | Supply and exhaust air diffuser | 24 h/day | ☐ Airflow need when occupied/unoccupied<br>☐ Control: presence, CO2 and temperature<br>☐ Noise generation - attenuation<br>☐ Capacity: pressure loss - airflow<br>☐ Thermal comfort (temp, air speed) | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| Other | For example emissions from building parts and furniture | | ☐ Are there equivalent materials and furniture with lower emissions?<br>☐ Is the cooling performed mainly with air or water system?<br>☐ Avoid warm ducting in cold attic<br>☐ Avoid cold ducting in warm attic | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |

# V – Ventilation - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

Aid:
(insert relevant norms/guidelines for the country)

# Hot water - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | System part: | Operation time: Fill in | To take into account: Exemples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result<br>**Reporting:** Comments to chosen solution. Refer to documents where the result, assessment etc.are presented. | **Follow-up needed?** If follow-up is needed, write down what needs to be followed up and when. |
|---|---|---|---|---|---|
| General | Hot water production | | ☐ Set up setpoints for hot water temperature. Take into account risk of legionella and energy consumption<br>☐ Control of inter-management of different hot water generators, such as with heat pumps or electric heating<br>☐ Are the requirements on the insulation of hot water tank met? | Comment:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Piping system | | ☐ Minimise piping length, no dead ends<br>☐ Check about the execution of insulation works<br>☐ Adjustment of VVC-flow | Comment:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Waste water | | ☐ Recovery of waste heat done as planned. Is cleaning possible? | Comment:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Energy requirements description, including Measurement plan for follow up – builder's requirement | | ☐ Requirements according to the energy requirements description which is valid for the production phase. | | |

# Hot water - Checklist for production



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | System part: | Operation time: Fill in | To take into account: Exemples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result | |
|---|---|---|---|---|---|
| | | | | **Reporting:** Comments to chosen solution. Refer to documents where the result, assessment etc.are presented. | **Follow-up needed?** If follow-up is needed, write down what needs to be followed up and when. |
| WC, shower, kitchen | Fittings | | ☐ Water saving fittings, do they meet the requirements according to project and client?<br>☐ Mixing of warm water from the central position in fittings | Comment:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | Washing machine, dishwasher | | ☐ Connection of machines to hot and cold water according to plan<br>☐ Do the energy performances of the machines comply with the design values? | Comment:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |

# Electricians - Checklist for production



Project:
Responsible:
Latest modified:

Accepted by:

……
Date Signature

| | | | | | |
|---|---|---|---|---|---|
| General | Energy requirements description, including Measurement plan for follow up – builder's requirements | ☐ Requirements according to the energy requirements description which is valid for the production phase. | Comments:<br><br>Reference: | ☐ Yes | ☐ No |
| | | | | What?<br><br>When? | |
| | Own controls | ☐ Verification of correct installation and functioning in connection with the installation<br>☐ Keeping of records | Comments:<br><br>Reference: | ☐ Yes | ☐ No |
| | | | | What?<br><br>When? | |
| | Installation | ☐ The equipment is mounted according to the documentation and in the places that are actual also under the production phase.<br>☐ The sealing round the perforations are made according to the instructions.<br>☐ The installation is coordinated, even timewise, with the other entrepreneurs. | Comments:<br><br>Reference: | ☐ Yes | ☐ No |
| | | | | What?<br><br>When? | |

# Electricians - Checklist for production



Project:
Responsible:
Latest modified:

Accepted by:

……
Date Signature

| | | | | | |
|---|---|---|---|---|---|
| | Setup parameters | ☐ Control system; for instance, check that the routines are correct.<br>☐ Electricity meter; check that measuring interval and resolution are correct. If the measurements are to be taken by a different system, verify that correct data is sent further. | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>Functional test.<br>When? | |
| | Cabling/wiring | ☐ Sealing of perforations, holes and cable routing are done according to instructions. | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? | |
| | Staircase lighting | ☐ Functioning according to plan.<br>☐ Turning on automatic or by button<br>☐ How many times it is calculated that the system will be turned on per day?<br>☐ Is it turn on/off or turn on/standby/off?<br>☐ The choice of lighting source will be considered together with the choice of control system and function for an optimisation of the lifespan of the lights and ballast. | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>Functional test of the control. Are the times correctly set up?<br>When? | |

# Control - Checklist for production



Project:
Resposible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | System part: | To take into account:<br><br>Examples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result<br>**Reporting:**<br>Comments to chosen solution. Refer to documents where the result, assessment etc.are presented. | **Follow-up?**<br>If follow-up is needed, state what needs to be followed up and when. |
|---|---|---|---|---|
| General | Installation | ☐ Sensors are installed according to instructions and on the respective measuring points for every measurement to be taken.<br>☐ Restoring of insulation on the piping and air ducts after that the sensor has been installed.<br>☐ Sealings (moisture, air tightness) around the perforations. Done according to instructions.<br>☐ The installation is coordinated, also timewise, with other entrepreneurs. | Comments:<br><br>Reference: | ☐ Yes ☐ No<br>What?<br><br>When? |
| | Settings | ☐ Setup of operating times and other time controls according to instructions<br>☐ Setpoints.<br>Temperature, flow, pressure etc.<br>☐ Larmgränser och larmrouting<br>☐ Checks of the setpoints with client and user to verify that they work | Comments:<br><br>Reference: | ☐ Yes ☐ No<br>What?<br><br>When? |

# Control - Checklist for production



Project:
Resposible:
Latest modified:

Approved by:

……
Date Signature

| Building part: | System part: | To take into account:<br><br>Examples on critical points, important moments etc<br>A ticked square means that the point has been taken into account | Result | |
|---|---|---|---|---|
| | | | **Reporting:**<br>Comments to chosen solution. Refer to documents where the result, assessment etc.are presented. | **Follow-up?**<br>If follow-up is needed, state what needs to be followed up and when. |
| | Own controls | ☐ Verification of correct functioning and mounting in connection with the installation<br>☐ Log keeping | Comments:<br><br>Reference: | ☐ Yes ☐ No<br>What?<br><br>When? |
| | Energy requirements description, including 2.2.2 Measurement plan for follow up – builder's requirement | ☐ Requirements according to the energy requirements description which is valid for the production phase. | Comments:<br><br>Reference: | ☐ Yes ☐ No<br>What?<br><br>When? |

# Measurements plan for follow-up

## Instructions

The purpose of this document is to summarise the requirements that are set by the quality assurance of the building process. It includes verifications of different kinds such as calculations, examination of documentation, visual checks, measurements and so on, including any requirements on competence. The first version of the measurements plan was prepared during the planning phase by the building owner (see document 2.2.2 Measurement plan for follow-up – building owner's requirements). The document has been completed during the course of the project and now it can be finalized by the contractor.

Fill in the table below for respective requirements (an example is shown).

| Building/ area | Functional requirement | Type of verification plus any skill requirements and time plan | Reporting | Responsible | Done | Result |
|---|---|---|---|---|---|---|
| *House A* | *Air tightness* | *Measurement according to EN 13829 in the finished building.*<br><br>*Moreover, search for air leaks before the construction works are done.* | *Written report* | *Contractor* | *Date /sign* | *OK, possible ref. to result* |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

# Agenda for energy coordination meetings

Convenor: Energy coordinator or project manager

Summoned: Project manager
Representatives for contractors involved
Client

Those questions are appropriate to be taken up during meetings for energy coordination during the production phase

1. Planning of energy coordination, make up a plan or check that it is followed?
2. Making of perforations in the building
3. Will/have new conctractors/subcontractors come to the workplace? Have they gotten information about the energy goals for the building and the important rules of work conduct to reach the goals? (For example, that perforations should be made in a special way to ensure the air tightness of the building).
4. Works preparation for critical moments, such as installation of windows or insulation
5. Testing, measuring and following up according to the measurements plan during the production phase
6. Next meeting

This meeting should be held regularly during the production phase, separately or together with construction meetings or similar meetings.

Who is to partecipate and how often the meeting should be scheduled is to be planned before the production phase starts.

# Energy round protocol 56 (3)

## Energy round nr:

| Project nr: | Project name: | Place: |
|---|---|---|
| Client: | Energy coordinator: | Construction manager/quality manager: |
| Date: | Contributors | |
| Submitted by: | | |

| Nr | Control point | Comments, deviations, proposals to corrective measures, reference to documentation | Assessment | | |
|---|---|---|---|---|---|
| | | | Correction needed | Follow up | OK/ not relevant |
| **1** | **Protection of materials and construction** | | | | |
| 1.1 | Are the controls for the received materials and products made according to plan? | | | | |
| 1.2 | Is there the possibility to store products and materials in a dry place? | | | | |
| 1.3 | Are materials and products stored safely from moisture, dirt and damage? | | | | |
| 1.4 | Did moisture sensitive materials (such as mineral wool, wood, plasterboards) moisten? State which materials, where and to which extent. | | | | |
| **2** | **Insulation** | | | | |
| 2.1 | Was the insulation installed correctly? Check for example filling, joints, fibre direction of the boards and density of loose insulation. | | | | |
| 2.2 | If applicable, was the windbreak installed correctly? Check for example joints, connections and holes made to accommodate building services. Check especially the risk for wind penetration and water deflection. | | | | |
| **3** | **Air tightness** | | | | |
| 3.1 | Are there detailed construction plans at the workplace (drawings of details, descriptions, control points and so on) to describe how to make the construction airtight? | | | | |

| Nr | Control point | Comments, deviations, proposals to corrective measures, reference to documentation | Assessment | | |
|---|---|---|---|---|---|
| | | | Correction needed | Follow up | OK/ not relevant |
| 3.2 | In case of light constructions: check the installation of airtight membrane. Check for example the joints of the plastic film, the taping, clamping and etc. Check also the moisture content. | | | | |
| 3.3 | Were the joints made airtight? Check the execution for example at windows, corners, intersection of the slabs with outer walls, connections between wall elements etc. | | | | |
| 3.4 | Were any perforations in the membrane made airtight? | | | | |
| 3.5 | Are the prescribed products used to make perforations and joints in the airtight membrane? | | | | |
| 3.6 | Was it performed or will be performed an early search for leaks in the airtight membrane? | | | | |
| **4** | **Building systems** | | | | |
| 4.1 | Are open ducts and air terminals conveniently covered? | | | | |
| 4.2 | Have the installations been well-insulated? Check the execution of works for both heat insulation and condensation protection for air and liquid-circulating installations. | | | | |
| 4.3 | Were the condensation protections installed before operation? | | | | |
| 4.4 | Were the perforations made according to instructions? Consider for example air tightness and leak safety. | | | | |
| 4.5 | Have pressurised pipes been pressure tested before they were mounted? | | | | |
| 4.6 | Was there any leakage from the building systems?<br>State type of system and extent of leakage. | | | | |
| **5** | **Cleanliness of surfaces** | | | | |

| Nr | Control point | Comments, deviations, proposals to corrective measures, reference to documentation | Assessment | | |
|---|---|---|---|---|---|
| | | | Correction needed | Follow up | OK/ not relevant |
| 5.1 | Is there any dirt or debris on surfaces? Check for example brick structures before building on. | | | | |
| 5.2 | Are the surfaces of heat exchangers clean and protected from dirt? | | | | |
| 5.3 | Are the air ducts and parts of the air handling unit clean and protected from dirt? | | | | |
| **6** | **Drying** | | | | |
| 6.1 | Is the drying process hastened? State method and duration. | | | | |
| 6.2 | Are the moisture measurements done as planned?<br>State method, who does the measurements and their extent. | | | | |
| 6.3 | Are there any results from the measurements? Report if there are any non-compliant ones, their cause, corrective measure. | | | | |
| **7** | **Check of the execution of the critical constructions.** | | | | |
| 7.1 | Were the critical constructions controlled during the present check? | | | | |
| 7.2 | Were the critical constructions documented? | | | | |
| 7.3 | Were the works prepared according to plan? | | | | |
| **8** | **Other** | | | | |
| | | | | | |
| | | | | | |
| **9** | **Next energy check** | | | | |
| | | | | | |
| | | | | | |

| The checks above were done by: | Date: |
|---|---|
| Inspector, signature. | Representing the contractor, signature. |

Any attachments are shown below. For example, drawings with notes for observed faults, measurement results, deviations, photos.

# Moisture round protocol 59 (3)

## Moisture round nr

| Project nr: | Project name: | Place: |
|---|---|---|
| Client: | Moisture safety responsible production: | Cosntrucion manager/ control manager: |
| Date: | Contributors | |
| Performed by: | | |

| Nr | Control point | Comments, deviations, suggestion to corrective measure, reference to document | Assessment | | | |
|---|---|---|---|---|---|---|
| | | | Intervention required | Follow up | OK | Not relevant |
| 1 | Protection of materials and construction | | | | | |
| 1.1 | Are the reception controls for materials and products done according to plan? | | | | | |
| 1.2 | Is dry storage of material and products possible? | | | | | |
| 1.3 | Are materials and products stored safe from moisture, dirt and damage? | | | | | |
| 1.4 | Is the indoor climate at workplace logged?<br>RH (%), temp (°C), vapour cont g/m³ | | | | | |
| 1.5 | Is the outdoor climate logged?<br>RH (%), temp (°C), vapour cont g/m³ | | | | | |
| 2 | Leaks, rainfall | | | | | |
| 2.1 | Have water leaks or intense rains occurred? State where and to which extent.<br>Mark it on the blueprint. | | | | | |
| 2.2 | Was water used during perforations? State where and to which extent. | | | | | |
| 2.3 | Is there any working procedure to manage a leak? | | | | | |
| 2.4 | Is there any system to lead away the rain from the roof or other horizontal surfaces? | | | | | |
| 3 | Moisture in the material | | | | | |
| 3.1 | Is there any wood-based material (installed or not) that absorbed moisture?<br>State where and to which extent.<br>State where on the blueprint. | | | | | |

| Nr | Control point | Comments, deviations, suggestion to corrective measure, reference to document | Assessment | | | |
|---|---|---|---|---|---|---|
| | | | Intervention required | Follow up | OK | Not relevant |
| 3.2 | Have measurements about the moisture content in wood or wood-based materials been done? State results, measurement method and who did the measurements. | | | | | |
| 3.3 | Did plaster absorb moisture? State where and to which extent. | | | | | |
| 3.4 | Lowest measured outside temperature on wood-based materials in °C<br>Climate RH% och temp °C outside and inside | | | | | |
| 3.5 | Did other moisture sensible materials (such as mineral wool, compensate boards, other boards etc) absorbed water? State which materials and to which extent. | | | | | |
| 4 | Drying of concrete | | | | | |
| 4.1 | Is there water on the slabs?<br>State extent and duration of the water presence. Mark it on the blueprint. | | | | | |
| 4.2 | Did the timeplan for casting, drying climate or type of concrete quality or surface layer change based on the original conditions? State how this will influence the drying time of the concrete structure. | | | | | |
| 4.3 | Was the drying process hastened? State method and duration. | | | | | |
| 4.4 | Are the measurements of relative humidity in the concrete done according to plan?<br>State the method, who does the measurements and to which extent. | | | | | |
| 4.5 | Are there any results from measurements? State any abnormal results, cause and corrective measures. | | | | | |
| 5 | Technical systems | | | | | |
| 5.1 | Are open channels and devices protected with covers? | | | | | |
| 5.2 | Were the pressurised ducts tested before they were installed in the building? | | | | | |

| Nr | Control point | Comments, deviations, suggestion to corrective measure, reference to document | Assessment | | | |
|---|---|---|---|---|---|---|
| | | | Intervention required | Follow up | OK | Not relevant |
| 5 .3 | Was any leakage detected from the technical systems?<br>State type of system and extent of the leak. | | | | | |
| 6 | Cleanliness of surfaces. | | | | | |
| 6.1 | Is there any dirt or debris on the surfaces? | | | | | |
| 6.2 | Was the concrete cleaned before it was coated with plastic sheeting, air gap building mat or other layers? State method and extent. | | | | | |
| 7 | Check of execution of moisture critical constructions according to moisture plan | | | | | |
| 7.1 | Were the critical constructions checked during the present round? | | | | | |
| 7.2 | Were the critical constructions documented? | | | | | |
| 8 | Air tightness | | | | | |
| 8.1 | Were the airtight measures, such as overlap, clamping when joining the plastic membrane, sealing at perforations, type of plastic film controlled? | | | | | |
| 9 | Other | | | | | |
| | | | | | | |
| | | | | | | |
| 10 | Next moisture round | | | | | |
| | | | | | | |
| | | | | | | |

| The above checks are performed: | Date: |
|---|---|
| Client's moisture expert, signature, | Moisture safety responsibel for production, signature. |

* Attachment: blueprints with marks for water on the structure and moist materials, measurement results, deviation reports, pictures.

# Checklist for production – Air tightness



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Air tightness detail: | To consider:<br>Exemples of critical points, important moments etc.<br>A ticked box means the point is taken into account. | Result<br>**Reporting:**<br>Comments to the chosen solution.<br>Reference to docuents where the result, assessment etc. are reported. | **Follow-up required?**<br>If follow-up is required, state what has to be followed up and when. | |
|---|---|---|---|---|
| Joints, connections, and perforations in the airtight layer. | ☐ Establish control points for the execution of joints, connections and perforations according to the drawings and procedures which are established by the planner. | Comments:<br>Reference: | ☐ Yes | ☐ No |
| | | | What?<br>When? | |
| | ☐ Plan as few joints/seams as possible. | Comments:<br>Reference: | ☐ Yes | ☐ No |
| | | | What?<br>When? | |
| | ☐ When using a sealing method based on adhesive, the material must clean and dry in correspondence of the surfaces that will be glued. | Comments:<br>Reference: | ☐ Yes | ☐ No |
| | | | What?<br>When? | |
| | ☐ When using a sealing method based on clamping of materials which will shrink/expand considerably due to moisture (such as wood), it must be assured that the materials are dry so that when drying further up they will not shrink further and therefore risk to worsen the clamping effect. | Comments:<br>Reference: | ☐ Yes | ☐ No |
| | | | What?<br>When? | |

# Checklist for production – Air tightness



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Air tightness detail: | To consider:<br>Exemples of critical points, important moments etc.<br>A ticked box means the point is taken into account. | Result<br>**Reporting:**<br>Comments to the chosen solution.<br>Reference to docuents where the result, assessment etc. are reported. | **Follow-up required?**<br>If follow-up is required, state what has to be followed up and when. |
|---|---|---|---|
| | ☐ Choose constantly airtight solutions (choice of solutions themselves, appropriate materials and combination of materials) that will resist through the lifecycle of the building. When using tape, sealants and similar, there has to be documented proof that the material is resistant in relation to the application to the other material it will be mounted on. It is also important that the adhesion is good under the prevailing conditions (such as temperature). | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | ☐ For light structures: the airtight plastic membrane should be installed so that no folds or bubbles arise. This might make the layer lose its airtightness. | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | ☐ For light structures: when installing the tiling, to get the desired clamping effect it does matter the orientation of the board in relation to the the joists. The orientation of the boards has to be the same as the joist it will be squeezed into. | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |
| | ☐ Are all the constructions that have joints/seams reported? The seldom occurring ones are also important, such as terraces or bay windows. Establish a dialogue with the project manager if not all the details are reported or if the execution is unclear. | Comments:<br>Reference: | ☐ Yes ☐ No<br>What?<br>When? |

# Checklist for production – Air tightness



Project:
Responsible:
Latest modified:

Approved by:

……
Date Signature

| Air tightness detail: | To consider:<br>Exemples of critical points, important moments etc.<br>A ticked box means the point is taken into account. | Result<br>**Reporting:**<br>Comments to the chosen solution.<br>Reference to docuents where the result, assessment etc. are reported. | **Follow-up required?**<br>If follow-up is required, state what has to be followed up and when. | |
|---|---|---|---|---|
| Early search for air leaks | ☐ To detect leaks at an early stage, a preliminary search can be made without the aim of giving out an exact result of the air tightness of the structure, but rather to identify the possibility for improvements. | Comments:<br>Reference: | ☐ Yes<br>What?<br>When? | ☐ No |
| Early test for air tightness | ☐ A part of the building should be completed as early as possible to assess if the solutions are airtight enough. The localization of the leaks is done with the help of thermography, anemometers or smoke devices. The tests have to be made before the inner boards are installed and the superficial layers completed. Improvements and corrective measures are taken so that the building solutions are actually airtight. Such measures are implemented in the rest of the building. | Comments:<br>Reference: | ☐ Yes<br>What?<br>When? | ☐ No |
| Air tightness testing searching for leaks | ☐ X air tightness tests with air leaks search are made and documented under the project's course. The different steps should be reported. Any possibility for improvement should be identified and communicated to the project team. | Comments:<br>Reference: | ☐ Yes<br>What?<br>When? | ☐ No |
| General | ☐ Care is to be taken so that no holes or tears will happen in the airtight layer. In such a case, careful sealing has to be done.<br>☐ Before building further on the airtight membrane, an accurate control has to be done to ensure that no damage or leaks are present. Photo documentation is recommended. | Comments:<br>Reference: | ☐ Yes<br>What?<br>When? | ☐ No |

# Deviation report

| Project nr: | Project name, place: | Date/Rev.date: | Set up by: |
|---|---|---|---|
| | | | |

| Construction manager: | Site manager: | Deviation report nr: |
|---|---|---|
| | | |

| Work moment: | Deviation discovered: | time: |
|---|---|---|
| Requirement: | | |
| Description of the deviation and consequence: | Date | |
| Main cause for the deviation: | | |
| Proposal for corrective measure:<br><br>Client's opinion is desired: Immediately ☐ At the latest: Not required ☐ | | |
| Measure to avoid repetition (corrective measure): | | |
| Following measure(s) has been decided and will be taken:<br><br>The measures are decided together with the client and have been approved:<br>Place: Date: Client's signature: | | |

| The agreed measures have been completed: | Date: | Signature: |
|---|---|---|