D3.1 Technical supervision procedures and quality assurance control plan for three demo sites

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D3.1

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Executive summary

The DREEAM approach aims to demonstrate net zero energy renovation approaches achieving 75% net energy demand reduction. The approach will be demonstrated in different climates at three pilot sites across Europe.

DREEAM work package 3 (WP3) focuses on the realization of the nZEB renovation works in DREEAM pilot sites and includes **task 3.1** on technical supervision. The objective of task 3.1. is to make sure that there is a consistency between the DREEAM approach and the works executed at the pilot sites, making sure that the project technical objectives are aligned through all the WP1, WP2 and WP3 as well as between the three pilot sites in Italy, UK and Sweden.

SP will perform the technical supervision (procedures and checks). The supervision will include site visit (3 per site) at the major milestones of the renovations works, including the start of works, installation of major technical elements, and the finalisation of work.

As a part of a technical supervision SP has developed a plan for a quality assurance monitoring during the construction process for each demo site (**D3.1 Technical supervision procedures and quality assurance plan for three demo sites**). The report describes the important parts of a QA plan for renovation projects, which will be the starting point for the technical supervision in DREEAM. The DREAM QA plan is based on a previously developed systems within the IEE program, SQUARE (A System for Quality Assurance when Retrofitting Existing Buildings to Energy Efficient Buildings) and SP-developed systems for moisture-proof, airtight and energy efficient buildings (ByggaL ByggaF and ByggaE). The plan includes self-inspection techniques and processes, which will be performed by handyman or builder at the construction site. The technical supervision will include both site visits by SP and the technical partners in DREEAM, as well as self-inspections performed by the building owners. Detailed plans for the supervision will be developed for each of the three pilot sites once information is available on the renovation measures to be implemented.

SP Technical Research Institute of Sweden will lead the DREEAM technical supervision, which will be carried in close collaboration with the building owners.

The results of the technical supervision will be continuously documented and reported in D3.4 and D3.6, at the start and finalization of the work on site.

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1 Introduction

1.1 The DREEAM approach

The DREEAM approach aims to demonstrate net zero energy residential renovation approaches achieving 75% net energy demand reduction by using interconnected energy systems that achieve a balance between energy efficiency and renewable energy measures. The DREEAM approach will be demonstrated at three pilot sites across Europe in three climatologically different locations, with the buildings also featuring different typologies (single- and multi-family), energy sources (gas, electricity, district heating) and construction features.

The objective of work package 3 (WP3) is to renovate three multi-building residential districts using insights from the DREEAM approach. The aim is to demonstrate the DREEAM approach and renovation strategies in real renovation projects. With support from the project partners, building owners will complete the renovation. WP3 includes the technical supervision and evaluation of the work on site which will be further described in this report.

1.2 Task 3.3 – Technical supervision

The first objective of Task 3.3 in the work program within DREEAM is to outline the strategy for the technical supervision procedures and quality assurance control plan for the three demonstration sites, making sure that the technical objectives align with WP1, WP2 and WP3 as well as between the three pilot sites in Italy, UK and Sweden. Secondly, the objective is to perform the technical supervision in close collaboration with the building owners and project partners to identify and resolve issues that may arise during the renovation works. The technical supervision will result in an evaluation of possible optimization and improvement of the DREEAM approach. The technical supervision will include both self-inspection routines throughout the renovation process, as well as site-visits by DREEAM technical experts. The site-visits will be carried out on three occasions per site during the renovation.

1.3 Aim for Deliverable D3.1

This report will outline the general technical supervision procedures, which will then be adapted for each pilot site depending on the specific renovation measures to be applied. The report will first present existing systems for quality control covering the building process from early stages to post renovation follow-up. This background will be used as a starting point for the implementation of the technical supervision procedures in DREEAM. Following this background, the report will suggest an approach for creating individual supervision procedures for each of the pilot sites to fulfill the objectives of Task 3.3. It will also describe how the technical supervision could be performed, including responsibilities for all partners involved. At the time of finalizing this report the specific renovation measures for each pilot site were not decided, thus specific supervision procedures will need to be agreed with each building owner at a later stage of the project.

2 Aspects of QA systems in renovation projects

2.1 SQUARE

The project SQUARE (EIE/07/093/SI2.466701), which stands for A System for Quality Assurance when Retrofitting Existing Buildings to Energy Efficient Buildings, was co-funded by the European Commission and supported by its Programme Intelligent Energy Europe (IEE). The SQUARE project aims to assure energy efficient retrofitting of social housing with good indoor environment, in a systematic and controlled way. SQUARE has presented necessary tools to optimize the process in achieving energy effective renovation with good indoor environment and it is here suggested that this concept is used as a starting point for the technical supervision in DREEAM.

Information from the SQUARE-project is easily assessable via the project website, see link below. It contain the reports (Kovacs and Mjörnell, 2010b), (Kovacs and Mjörnell, 2010a), (Geier, 2010) and (Mjörnell et al., 2010).

Link to SQUARE project website:
SQUARE - Homepage. A Quality Assurance system - an important tool for all building owners!

2.2 Measures influencing energy efficient renovation

In (Mjörnell et al., 2010), the energy saving potential in the European multifamily housing stock is presented. The age distribution of the multifamily housing stock is discussed, existing amount of refurbished housing, the estimated costs for renovation per year and the potential for energy efficiency. Furthermore, characteristics of three European climates are considered in this report for specifying energy improvement measures of buildings renovation (table 3, page 19 and forward in reference). For example in table 4 in the report, indoor environment parameters due to different climates are presented:

Table 4 Values of indoor environment parameters due to different climates. (Reference: Energy improvement measures and their effect on indoor environment, available at www.iee-square.eu.)

Climate	Warm	Temperate	Cool
Room temperature Winter/Summer (°C)	21/<26	20/<26	20/<26
Ventilation rate (ach) *or*	0.35 - 0.4	≥ 0.3	0.2 - 0.35
CO_2-concentration (ppm)	<1 000	800	900 - 1 000

Figure 1. Values of indoor environment parameters due to different climates. Table 4 in SQUARE Summary report (Mjörnell et al., 2010).

Link to SQUARE report:
SQUARE Result oriented Summary report

The energy use of a building depends both on the building envelope and on the building services systems which, in their turn, affect the indoor environment. Concentration excessively on either good indoor environment or energy efficiency might cause mutually negative effects, and it is important to avoid this, as pointed out in the SQUARE Summary report (Mjörnell et al., 2010).

The key objective for renovation of buildings targeting energy efficiency is very low primary and final energy input during planning, construction and operation stage. According to (Geier, 2010), two different types of measures must be in focus. Firstly the basic energy improvement measures to the building construction and components meant to meet basic requirements for an energy efficient building need to be met achieving good indoor environment before optimizing the building services. Secondly active measures that are meant to optimize the building service systems and bring them to a better performance should be introduced.

The following five basic and five active measures are suggested to be the most relevant for renovation of residential buildings (Geier, 2010):

- Complete exterior insulation
- Thermal optimized windows/doors
- Airtightness
- External shadowing
- Natural cooling requirements
- User's briefing/user's behavior
- Optimized heating system
- Use of renewable energy sources
- Optimized heating control systems
- Optimized ventilation system

For any measure, consideration must be taken to the impact on energy efficiency, impact on indoor environment, characteristic values to verify, verification references and best practice information (Geier, 2010).

In the SQUARE project, above stated important technical improvement measures for energy efficient renovation in different climates were presented, with priority measures suitable for different climates. The description of each measure includes information about values, their verification systems, their effect on indoor environment and "best practice" examples and links, which will be used as a guide for the DREEAM technical supervision depending on which measures that each of the pilot-sites will implement.

Link to SQUARE reports:
SQUARE Energy Improvement Measures and their Effect on the Indoor Environment _ ENG
The report is also available in English, Spanish, Bulgarian, Finnish, German and Swedish.
SQUARE Reports

2.3 Non-technical barriers

There are a number of non-technical barriers to overcome regarding economy, subsidies, regulations, behavior, attitude and culture in organizations and among users (Adjarova and Raicheva, 2010). Non-technical barriers and strategies for energy efficient renovation are described in this report, as general aspects and specifically for owners, developers, investors, tenants and building management. The aspects which will need to be considered in the development of a quality control system are divided into 6 areas:

- Current regulation impacting energy efficiency in social buildings
- National market structure
- Stakeholders – objectives and interests (experiences from sites in six countries)
- Barriers for different stakeholders (specific barriers for different stakeholders)
- Strategies for overcoming non-technical barriers for different stakeholders
- Conclusions for owners/developers/investors, tenants and building management

Links to SQUARE reports:
SQUARE Result oriented Summary report
SQUARE Non-technical barriers

2.4 Pilot projects in SQUARE with QA system

The following feedback originates from the results of the pilot projects in the SQUARE-project. The QA system for efficient energy use and improved indoor environment has been applied in four pilot projects involving renovation of social housing. These pilot projects were selected because they represented typical social housing structures in the participating countries and

were planning renovation initiatives which were supposed to be implemented in the years of the project duration.

The added value of taking part in the SQUARE project implies that the project stakeholders pushed the standard of refurbishment to more ambitious targets and that it was made in a methodological way thanks to the applied QA system. Dissemination of the experiences from the design, construction and operation of these pilot projects was a very important task in the SQUARE project. This included communication with tenants that gave valuable information to the evaluation.

Each pilot project is presented in an individual report with lessons learnt and identified barriers for implementing a QA-system. In the Austrian pilot project - Dieselweg, a total number of 49 apartments built in the 50's and 70's were renovated in the project located in Graz, Austria. In the Swedish pilot project – Brogården in Alingsås, 18 of 300 apartments were renovated. The apartments were built in the 60's/70's. In the Finnish pilot project, a student house with 33 flats built in 1970 was renovated. The goal was to reach passive house standard level, which for northern Finland is 30kWh/m^2 per year for heating energy. And finally, the Spanish pilot project consisted of a 6 apartments building located in the old town of a neighborhood in Barcelona. The building was built in 1890 and appeared extremely damaged and it was necessary to make a complete renovation.

The summary report of these pilot project aim to provide a review of the four projects renovated during the last three years in Sweden, Finland, Austria and Spain, focused on the implementation of the SQUARE's Quality Assurance System during the development of each pilot project, and the technical solutions applied in each pilot project adapted to each building conditions and climate.

Each national pilot project is available in the respective language.

Links to SQUARE homepage and reports:

SQUARE Pilot projects
SQUARE National pilot project in Austria - ENG
SQUARE National pilot project in Finland ENG
SQUARE National pilot project in Sweden ENG
SQUARE National pilot project in Spain ENG
SQUARE Reports

3 Quality Assurance Control Plan

3.1 Purpose of Quality Assurance Systems

To achieve the intended results of a renovation requires knowledge transfer, continuity and communication is needed. This can be assured by applying a quality assurance system (QA)

which supports a systematic and controlled way of working. Aspects such as local resources, costs, building traditions, legislation and financing have impact on decision-making and consequently the outcome of the retrofit. (Kovacs and Mjörnell, 2010b)

The main purpose of applying a QA system is to ascertain that all defined requirements on indoor environment and energy performance are reached at the end of the project. This can be achieved by focusing on management/supervision of the renovation process through a thorough pre-study of conditions prior to renovation, on formulation of requirements and targets to be integrated in the designing process and on description and analysis of the different measures that can be applied in order to reach the targets. Careful definition of the requirements on the monitoring systems for indoor environment and energy use of the building after it has been taken into use is very important for a successful implementation of the second part of the process (Kovacs and Mjörnell, 2010b). To make sure that the objectives are being met during renovation, there is also a need for continuous follow-ups during the on-site work to make sure that renovation measures are installed correctly.

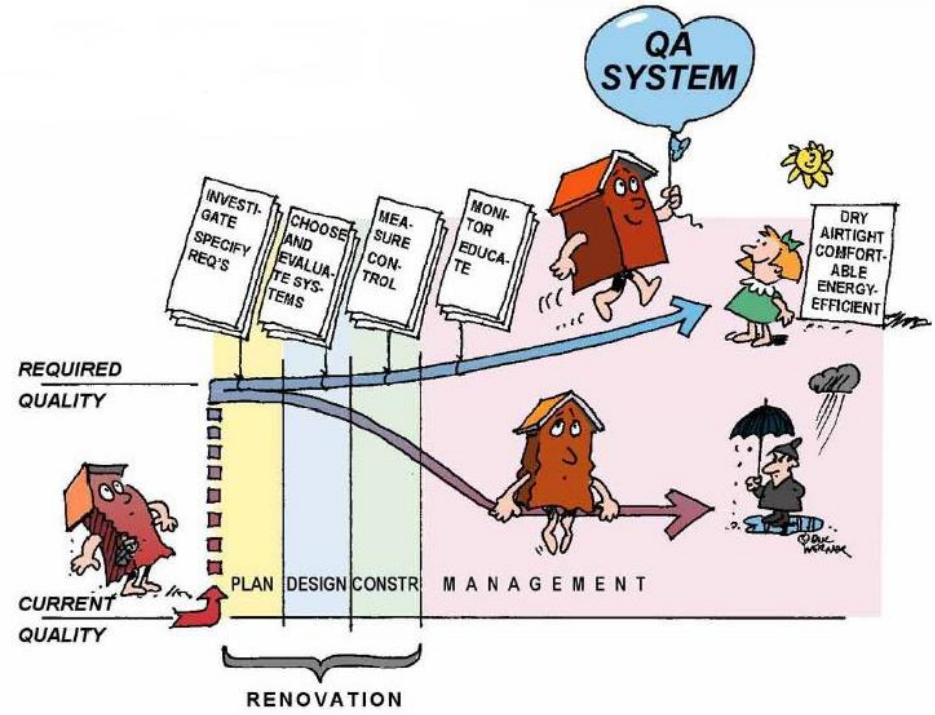

Figure 2. Role of the QA system in the renovation process. (By courtesy from professor K Mjörnell, SQUARE project coordinator)

3.2 Required content of QA Control Plan

A complete QA system should cover both the renovation process and maintenance. Experience shows that a successful energy improvement renovation will be permanent only if use of the building is guided by effective routines and continuous knowledge building of all parties involved

(Kovacs and Mjörnell, 2010b). In Sweden, such a quality assurance system has been developed considering both indoor environment and energy use. The system is applicable to most types of multi-family housing that is to be renovated and updated to modern standards concerning indoor environment and energy use. It has been translated and presented within in the SQUARE project and reported in detail in (Kovacs and Mjörnell, 2010b), (Kovacs and Mjörnell, 2010a), available in Swedish, English, Austrian, Dutch, Finnish and Spanish.

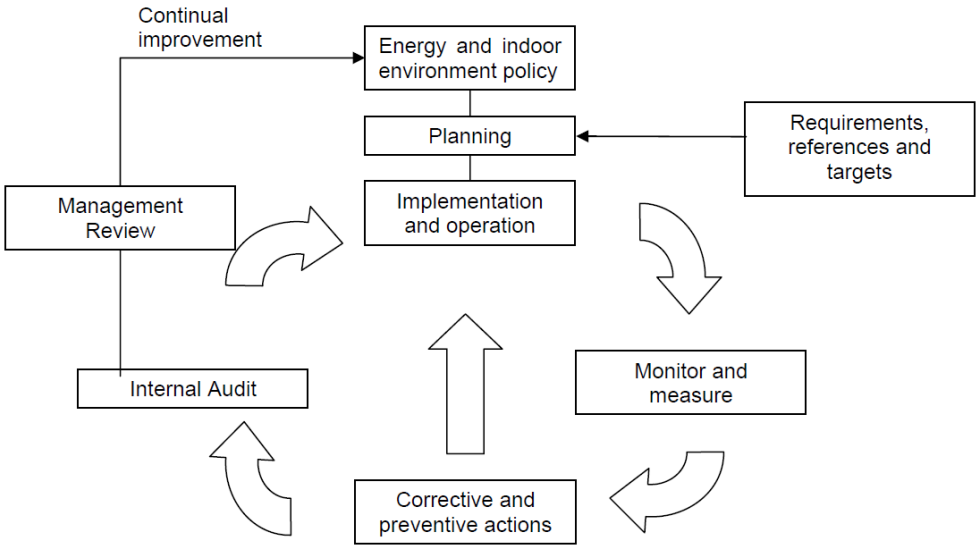

Figure 3. The organizational system model of quality assurance (Kovacs and Mjörnell, 2010b)

First it it is necessary to identify a reference policy for energy use and indoor environment. Based on the policy, the QA system can be established, documented, implemented and maintained, see (Kovacs and Mjörnell, 2010b) for details. The report describes functional requirements and targets, the quality assurance process for renovation and property management and further, also describes necessary documentation and routines. In the report, methods for monitoring, metering, measurements and tests are described. The complementing report (Kovacs and Mjörnell, 2010a) presents a practical guidance which sets out complete and formal requirements of such a quality assurance system.

3.3 The SQUARE project QA system

3.3.1 The elements of the QA system

In the SQUARE QA system for energy efficient renovation the essential and detailed elements, as well as targets are described for the renovation process including commissioning and facility management. Central to this system is a dialogue and cooperation between stakeholders, formulation of the follow-ups of requirements and targets. See figure 4 below for an overview of the process.

Figure 4. Elements in the SQUARE QA system

3.3.1.1 QA system General

The SQUARE QA system in general describes the logical structure for the essential parts, but is mainly restricted to the formal parts of the system. The different chapters in the QA general report contain the following topics that need to be addressed:

a. QA system requirements of organization, responsibilities, procedures and documentation
b. Functional requirements, definitions and targets on indoor environment and energy use
c. QA procedures for the renovation regarding TPI, FEA renovation concept and check-ups
d. QA procedures for the property management of operation, maintenance, monitoring, non-compliances, communication and information flows, education of staff, internal audits and management reviews
e. Documentation and document control, records, templates, procedure documents
f. Methods for monitoring, metering, measurements and tests of indoor environment parameters, heat, electricity and water metering, air tightness and air flows, user questionnaires
g. Third party certifications
h. References
i. Appendices with specified requirements on the indoor environment from Swedish example (thermal comfort, air quality, materials, radon, ventilations, moisture safety, air tightness, acoustic conditions, light, tap water, administration)
j. Requirements on the energy use from Swedish example (emissions of greenhouse gases, energy requirements for particular components, the purchaser's own requirements)

Finally, in the appendices, suggestions (Swedish example) of requirements on the indoor environment and energy use are presented.

Links to SQUARE report:

SQUARE QA system General EN

The SQUARE QA system General version is also available in German, Bulgarian, Finnish, Spanish and Swedish. See SQUARE Reports.

3.3.1.2 QA system Guide

Before a decision is made on renovation measures, it is essential to carry out a Thorough Primary Inspection (TPI) and a First Energy Analysis (FEA) of the building. The results of the TPI will be the basis of a supporting documentation of the QA together with measurements and calculations, target values, requirements for indoor environmental conditions and energy use.

Following the link to the SQUARE QA system Guide report (Kovacs and Mjörnell, 2010a) will provide an overview of descriptions of the QA-routines and information for monitoring and measuring. The report presents requirements for indoor environments (appendix A) and the requirements on the energy use (appendix B) as Swedish examples. For more detailed information of the procedures and QA control plan see the appendices in (Kovacs and Mjörnell, 2010a).

The QA Guide contains a complement guide for implementation, with checklists, descriptions and templates and guidance on appropriate methods of measurements and instrumentation.

The guide contains the following chapters:

- Introduction to QA of indoor environment and energy performance in renovation projects
- Preparing the QA system
- Applying the QA system to the renovation process
- Good examples from renovation of apartment buildings (four different)
- Appendices with:

  a. Checklist for controlling documents in the QA system
  b. Checklist for descriptive documents
  c. Checklist for presentational documents/records
  d. Examples of templates
  e. Checklist for internal audits
  f. Checklist for management reviews
  g. Procedure for dealing with non-compliances
  h. Non-compliance reports
  i. Procedure for dealing with complaints about indoor environment conditions (Swedish example)
  j. Questionnaire – my home environment
  k. A checklist for a thorough primary investigation (TPI)
  l. Inspection record form for apartments (example)
  m. Checklist and templates for first energy analysis (FEA)
  n. Template for setting energy targets (example)
  o. Template for selecting instrumentation for energy monitoring
  p. Methods of measurement, measuring instruments and calibration (guidelines)
  q. An agenda for progress meetings
  r. Checklist for inspection rounds

Links to SQUARE reports:

SQUARE QA system Guide EN

The report is also available in German, Dutch, Finnish, Spanish and Swedish.

See SQUARE Reports .

3.4 Scope and limitations for technical supervision in DREEAM

Above descriptions of how to develop and implement quality assurance procedures, will constitute the starting point for the DREEAM technical supervision. The QA-systems described address phases from early conception to post renovation follow-up, which is necessary to ensure good quality, the DREEAM technical supervision will however focus on the on-site renovation works, thus only the tools for this phase will be implemented. Ensuring high quality renovation measures that meet the goals in terms of energy efficiency and tenant satisfaction will be addressed in WP1 and WP2. Assessment and monitoring will be addressed in WP4. Information from these work packages will serve as input to the individual technical supervision plans for each of the three pilot sites.

4 Technical supervision procedures

4.1 Introduction and aim of the technical supervision and QA

The purpose of the technical supervision is to follow the renovation works on site and to evaluate how previously established quality requirements in WP1 and WP2 are met when executing the works. The supervision will also make sure that the renovation is performed according to the concept chosen by the building owners and developed in WP2. This chapter presents a proposed approach for the technical supervision. The supervision will be performed both through on-site visits and QA checks performed by the building owners and contractors in between the site visits attended by DREEAM technical partners. The aims of the supervision are to:

- Follow the renovation process and verify that solutions are installed correctly to ensure that quality requirements on energy efficiency, indoor environment and moisture are met
- Evaluate the correlation between the renovation projects and DREEAM WP1 and WP2

4.2 Supervision process

4.2.1 Overview and timeline

Requirements on energy, indoor environment and moisture from both the building owners and the DREEAM project established during design and planning of the renovation projects will be used as input to the technical supervision. The established requirements will be the basis for choosing relevant indicators for the QA and technical supervision. DREEAM Task 3.1 *Preparation and tendering of pilot projects* will introduce quality control and technical assessment through a discussion of requirements on the renovation projects regarding abovementioned aspects. Site visits will be scheduled with each building owner individually based on the most suitable phases of the renovation works. In between visits, building owners and contractors will have a continuous dialogue with the technical supervisors as well as being responsible for day to day QA controls.

To create an efficient technical supervision process any relevant and already existing QA-systems of the building owners will be complemented with additional QA as described in this report to create a complete system for evaluation of the quality of the work on site.

4.2.2 Link between the renovation projects and DREEAM

The output from the QA controls performed by the building owners and the contractors as well as the outcome of the technical supervision visits will provide feedback to the DREEAM approach, thus providing the possibility for continuous improvements of the approach as well as the solutions therein. Figure 5 below describes the supervision flow and links between the renovation projects and the DREEAM approach.

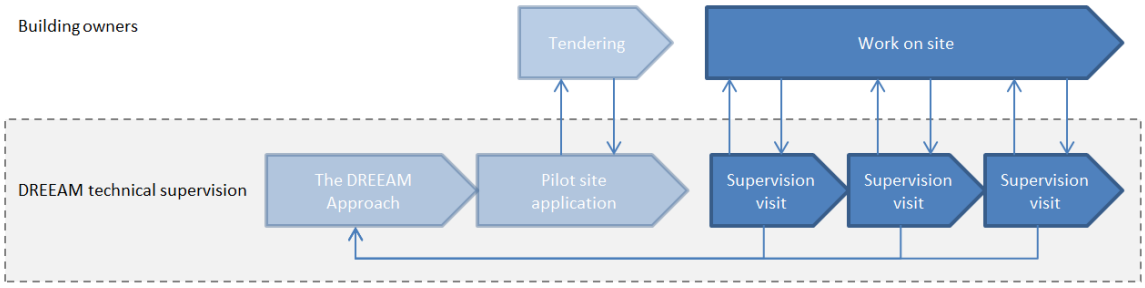

Figure 5. Supervision and feedback flow. The top flow represents the building owners responsibilities. The bottom flow represents the DREEAM technical supervision approach and how information from the technical supervision provides input to the work on site as well as the continuous development of the DREEAM approach.

4.2.3 Supervision meetings and visits

SP Technical Research Institute of Sweden will lead the supervision. Active participation of the contractors and building owners are however essential for achieving good results in the technical supervision and QA control. Below all meetings are described and what information is required by each partner in preparation for the meeting. Table 1 presents an overview of the technical supervision visits which will serve as a basis for further discussion on how to develop individual supervision procedures for the three pilot-sites.

Visit 1 – Meeting - Establish routines

Goal: The supervision process will start with the establishment of how the technical supervision for each renovation project practically will be carried out and by which stakeholder. At the first meeting it will be establish how the DREEAM QA-approach will complement existing QA-routines already in use by the building owners or contractors. This meeting will result in a QA-control plan for how supervision and self-inspections will be performed throughout the renovation process, relevant package of checklists will be compiled and it will be agreed how the results will be reported.

Information and preparations: In preparation for this meeting relevant QA control already in use by the building owners and contractors needs to be made available for the meeting participants, as well as existing requirements on quality for the work on site. Also renovation measures to be applied need to be made available for the meeting participants.

Participants: Building owner (QA responsible, project manager), Contractors, Technical supervisor (SP), Technical specialists (DREEAM partners).

Expected outcome: As a result of the meeting including follow up work, quality targets and control procedures will be defined, as well as the responsibilities of the partners and a timeline for technical supervision of each pilot site.

Visit 2 – Technical supervision I - Start of the renovation works

Goal: First supervision visit at the start of the renovation will follow up on the first meeting with regards to understanding how QA-procedures have been implemented and how they will be carried out during the pilot site renovation. Visit 2 will include a site visit to review the status of the renovation works to discuss any questions that may have arisen regarding QA or the DREEAM approach. The goal of the visit is to resolve any issues in the early phases of the renovation from the building owners or contractors side. Furthermore the aim is for the technical supervisor to understand the consistency between DREEAM WP1, WP2 and the work on site.

Information and preparations: Prior to the visit, the building owners are required to set up a site visit and collect issues and questions regarding DREEAM technical solutions and QA. The technical supervisor will provide preparation instructions for the meeting.

Participants: Building owner (QA responsible, project manager), Contractors, Technical supervisor (SP), Technical specialists (DREEAM partners)

Expected outcome: Possible issues will be addressed and resolved regarding building owner's implementation of QA and the technical solutions. D3.4 *First supervision report* will be produced following the start of the work on site.

Visit 3 – Technical supervision II - Key step of the renovation process

Goal: The main goal is to check the status of the QA work on site, gather feedback from contractors and building owners (technical and process) and to visit the pilot sites during installation of a major step in the renovation process. The overall aim of the visit is to ensure consistency between the DREEAM approach and the pilot projects and to evaluate QA so far in the renovation process.

Information and preparations: Prior to the visit, the building owners are required to set up a site visit and collect issues and questions regarding DREEAM technical solutions and QA. The technical supervisor will provide preparation instructions for the meeting.

Participants: Building owner (QA responsible, project manager), Contractors, Technical supervisor (SP), Technical specialists (DREEAM partners)

Expected outcome: Possible issues will be addressed and resolved regarding building owner's implementation of QA and the technical solutions. Following visit 3, SP will collect and document QA-status and progress, input on potential improvements, as well as documentation of installation of chosen key step in the renovation process. Also consistency between the DREEAM approach and work on site will be evaluated.

Visit 4 – Technical supervision III - Finalization of the renovation works

Goal: To gather and evaluate QA and technical supervision from the pilot sites for the final report. The visit will also focus on possible improvements and optimization of technical solutions, as well as the consistency between the DREEAM approach and the work on site throughout the renovation project.

Information and preparations: Before the final visit, building owners will be responsible for collecting QA information from the renovation process and evaluate possible scope for improvements and optimization to together with the contractor.

Participants: Building owner (QA responsible, project manager), Contractors, Technical supervisor (SP), Technical specialists (DREEAM partners).

Expected outcome: After this final visit on each building site, the technical supervisor will be responsible for finalizing D3.6 *Final report on technical supervision and quality assurance control* based on the collected QA information as well as documentation from the technical supervision throughout the renovation process.

Table 1. Overview of supervision visits

What	Duration	When	Goal	Supporting material and input	Expected outcome
Visit 1 - Meeting 1 – establish routines	Full day meeting	Before the start of the renovation works	• Adapt and establish routines for each pilot site	• DREEAM QA and Technical supervision procedures (this report) • Existing QA system • Quality requirements and expectations from T3.1 • Documentation of renovation measures	• QA-procedures, quality targets, reporting procedures and timeline for technical supervision for each pilot site • Responsibilities of partners
Visit 2 - Technical supervision I	Full day visit	Start of the renovation works	• Review pilot site QA implementation • Discuss and resolve issues regarding QA • Check status of the renovation works	• QA-routines and responsibilities • Questions regarding technical supervision and QA from building owner and contractor • Documentation of renovation measures	• First supervision report at the start of the works (D3.4) • QA issues resolved
Visit 3 - Technical supervision II	Full day visit	Key step of the renovation works	• Review pilot site QA checklists and controls • Discuss and resolve issues regarding QA • Check status of the renovation works • Gather feedback from contractors and building owners	• QA-documentation, routines and responsibilities • Questions regarding technical supervision and QA from building owner and contractor • Documentation of renovation measures	• Documentation of QA and consistency between the DREEAM approach and the works on site • QA issues resolved
Visit 4 - Technical supervision III	Full day visit	Finalization of the renovation works	• Review pilot site QA checklists and controls • Check finalized results of the renovation works • Evaluate scope for improvements and optimization	• QA-documentation • Evaluation of possible improvements • Documentation of renovation measures	• Final report on technical supervision and the QA-control (D3.6)

4.2.4 Responsibilities

Effective technical supervision will require collaboration between involved stakeholders. Table 2 below describes suggested responsibilities of stakeholders in the renovation projects.

Table 2 Responsibilities

	Building owner	Contractors	Technical supervisor	DREEAM Technical Experts
QA	• Provide information regarding already existing QA systems in cooperation with contractors • Together with technical supervisor design QA procedures • Responsible for on-site QA incl. documentation	• Provide information regarding already existing QA systems in cooperation with building owners • Conduct QA controls on-site as instructed by the building owner	• Responsible for design of QA-procedures assisted by building owner • Support other partners with QA competence • Collect and organize QA documentation	• Provide technical understanding of renovation measures
Technical supervision	• Organize technical supervision visits on the pilot site	• Participate in technical supervision visits	• Lead technical supervision • Provide technical understanding	• Attend site visits when required • Provide technical understanding
Reporting	• Provide input from continuous QA and technical supervision • Provide input on improvements and optimization		• Document technical supervision visits • Responsible for reporting QA and technical supervision	

4.3 Reporting

SP Technical Research Institute of Sweden will be responsible for reporting the technical supervision, including QA, supported by the building owners. Public deliverables (D3.4 and D3.6) will report at the initiation and finalization of the pilot projects.

Building owners and SP will collaborate continuously regarding QA to make sure that necessary information is available for evaluation and reporting.

The first supervision report at the start of the renovation works will focus on how QA has been implemented to support the technical supervision. It will describe the requirements and goals that should be verified by QA controls as well as how they should be performed. It will further describe how existing QA-systems have been complemented with QA tools described in this report.

Continuous documentation of QA and visits during the renovation projects will be made to facilitate final reporting at the end of the renovation works. Building owners will have the responsibility for completing day to day checklists etc. SP will have the responsibility to document technical supervision visits and continuous contacts regarding technical issues.

Final reporting at the end of the renovation works will evaluate and analyze technical supervision based on the supervision visits and continuous QA. Conclusions will be made regarding implementation of the technical solutions, possible scope for improvements and optimization as well as an evaluation of technical supervision during the project.

5 References

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