Health and safety in refurbishment involving demolition and structural instability

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RESEARCH REPORT 204
Health and safety in refurbishment involving demolition and structural instability

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The report documents the findings of the research project on ‘Health and Safety in refurbishment projects involving partial demolition and structural instability’. This final report, completed in 2003, summarises the results and is substantiated by the intermediate reports covering work packages WP1 to WP5.

The report identifies the main factors associated with health and safety issues on refurbishment sites and investigates the strategies adopted during refurbishment works involving demolition activities. A comparison between the practices in the UK and Italy was undertaken and a checklist for proactive management of health and safety on refurbishment projects was prepared. Based on the project’s findings recommendations are made for further research and for improvements in the industry practices.

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1. Introduction

This report documents the results of the Health and Safety Executive-funded research project at Loughborough University on ‘Health and Safety in Refurbishment Involving Demolition and Structural Instability’. The aim of this report is to summarise the findings of the research project, drawing on the considerations and results developed in the intermediate reports covering work packages WP1 to WP5. In this context references to the related intermediate reports are provided. The first part introduces the main contents of the research project illustrating the research background, objectives and methodology and the case studies that have been investigated. The next section discusses the key health and safety factors identified for refurbishment sites involving demolition activities and structural stability problems.

Recommendations related to key issues to be considered for the implementation of health and safety management strategies in refurbishment projects is also documented. The research work has highlighted the importance of proactive involvement of all the key functionaries for a better health and safety management of the whole refurbishment process. The report documents the key responsibilities for all the figures identified in the refurbishment process; the competencies of new professional roles such as the Temporary Structures Co-ordinator are also illustrated.

Communication throughout the stages of a refurbishment project has been revealed to be one of the most important health and safety issues in such projects. This is discussed further in Section 6. The report concludes with recommendations for further research based on the results achieved from this project.

2. The Research Project

2.1 Background

The past 30 years have witnessed a significant increase in refurbishment works both in the UK and Italian construction industries\(^1\). Although neither the UK nor Italy differentiates between new construction and refurbishment accident data, statistics suggest that refurbishment, in its different interpretations, accounts for a substantial proportion of injuries and fatal accidents. Recent provisional accident statistics provided by the HSE show that 40.6\% of construction fatalities occurred on refurbishment sites\(^2\).

The increase in refurbishment activity, and the corresponding increase in accidents related to it, surprisingly was not accompanied by any relevant empirical research especially in the management of health and safety. The new British Standard on Demolition, BS6187: 2000 is expected to lead to a more focused approach to demolition but the health and safety aspects of refurbishment works involving

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\(^1\) For statistical data regarding refurbishment sector output see paragraph 2.1 “Refurbishment in the UK and Italian construction industry” of the WP1 report - Key factors associated with the high rate of health and safety incidence on refurbishment.

\(^2\) These data however do not specify if these sites included demolition activities or temporary works.
demolition would still need to be addressed. Refurbishment works involving demolition and structural instability can be considered among the most dangerous activities to be undertaken on site and therefore in need of a rigorous health and safety management strategy. In this context the research work focused on sites where demolition and structural instability are involved therefore whenever it will be referred to refurbishment sites it will imply the presence of demolition and structural instability.

2.2 Research objectives

Due to the greater incidence of health and safety problems in refurbishment rather than new construction specific objectives were set up as follows:

**WP1**: To determine the main factors associated with the relatively high level of hazard and health & safety incidence on refurbishment involving demolition works;

**WP2**: To investigate the health & safety management strategies in current usage, for refurbishment work involving demolition activities;

**WP3**: To undertake comparative studies of the situation in the UK with that in Italy where there are many historic buildings and refurbishment works involving partial demolition are common;

**WP4**: To produce a checklist of issues to consider in managing Health and Safety incidence on refurbishment projects involving demolition work, and also to identify areas where guidance should be provided;

**WP5**: To make recommendations for further research in this area, as well as appropriate education and training provisions relevant to the major stakeholders associated with refurbishment activities involving demolition work.

**WP6**: Final Report

The research work aimed to address the lack of targeted studies on health and safety in refurbishment works by identifying and analysing those key factors that influence the health and safety management of refurbishment projects. In this context the research focused on refurbishment sites involving partial demolition due to the greater and more complex risks involved than in total demolition works. A combination of research strategies was used through the different stages of the research project:

- Review of UK and Italian accident statistics analysing, where possible, the incidence of demolition works;
- Review and elaboration of the incidence of demolition methods and techniques on refurbishment sites;
- Review of archive documentation from HSE, in particular accident investigation reports related to structural collapses;
- Selected interviews with health and safety officers and managers from contracting organisations, HSE representatives, structural engineers and site managers;

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3 For a more accurate definition of refurbishment see paragraph 2.1 of the WP1 report.

4 Total demolition works are often carried out with mechanical equipment and remotely from the construction to be demolished.
Case studies based on a selection of large and small refurbishment projects in the UK and in Italy involving demolition activities and temporary works.

2.3 Case studies

The research led to the identification of key health and safety factors; consequently it moved forward to select refurbishment sites suitable to verify and document the assessment of such key factors in the current practice. The number of case studies that were investigated in the research cannot be statistically analysed, however, they provided a significant insight into the refurbishment sector and the related health and safety issues. The typologies of the selected case studies, both in Italy and in the UK, covered different types of refurbishment sites as old residential houses, office buildings, industrial areas etc. Therefore the selected case studies present a comprehensive range of refurbishment, health and safety issues that allowed the development of all the findings and considerations of the research project.

3. Health and safety factors on refurbishment sites involving demolition activities and temporary structures

3.1 Demolition and temporary works in refurbishment projects

The first stage of the research project involved a review of the scientific and technical literature related to demolition methods, techniques and equipment employed on refurbishment sites. Such a review was necessary in order to acquire specific knowledge on the key health and safety issues related to demolition works. The British Standard 6187 “Code of practice for demolition” provided to be a very useful reference for the identification and classification of demolition methods and techniques.

The study of demolition methods led to the definition of the general risks involved in demolition operations. The review of technical literature and the analysis of HSE accident investigation reports showed that most of the health and safety risks in demolition activities are related to an unplanned or premature collapse of structure or of a part of it. It was therefore decided to focus the initial research activity on «why do collapses happen?»

3.2 Health and safety key factors in the demolition process

In order to investigate the predictable causes of structural collapses the demolition process was considered as an independent project with design, planning and execution phases. Such division of the demolition process facilitated the identification of key health and safety factors as reported in Table 1.

Once these factors were identified and analysed the research project progressed in the investigation of health and safety management strategies applied to refurbishment projects.
Table 1 – Identification of Key Health and Safety factors during demolition process phases.

<table>
<thead>
<tr>
<th>Demolition Phase</th>
<th>Key factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>• Structural knowledge of the structure;</td>
</tr>
<tr>
<td></td>
<td>• Structural knowledge of any adjacent construction;</td>
</tr>
<tr>
<td></td>
<td>• Demolition equipment and methods selection;</td>
</tr>
<tr>
<td>Planning</td>
<td>• Site knowledge;</td>
</tr>
<tr>
<td></td>
<td>• Health and Safety risk assessment;</td>
</tr>
<tr>
<td></td>
<td>• Development of safe sequences of demolition activities;</td>
</tr>
<tr>
<td></td>
<td>• Limitation of the level of subcontracting;</td>
</tr>
<tr>
<td></td>
<td>• Pre-qualification and selection of specialist contractors;</td>
</tr>
<tr>
<td>Execution</td>
<td>• Workforce supervision;</td>
</tr>
<tr>
<td></td>
<td>• Control of method statements implementation;</td>
</tr>
<tr>
<td></td>
<td>• Communication of unplanned discoveries;</td>
</tr>
<tr>
<td></td>
<td>• Safety information and training selection.</td>
</tr>
</tbody>
</table>

4. Key issues in health and safety management strategies for refurbishment projects

4.1 Investigation of current management strategies for refurbishment projects

In order to formulate appropriate recommendations for the assessment of the key health and safety factors identified in the first stage of the research project, and to associate them to a proper health and safety management strategy, it was necessary to undertake an investigation of current procurement routes in refurbishment projects. The traditional procurement routes that have been investigated are:

- Traditional;
- Construction management;
- Design and build;
- Demolition and temporary works as advanced packages.

The impact of traditional procurement routes on health and safety management strategies was then assessed. The results of this assessment suggested that the traditional form of procurement (general contractor and specialist subcontractors) could be the most suitable when based on an accurate pre-qualification of demolition contractors. Concern about demolition as an advanced package has been moved due to the selection methods used by Clients, which are often not as rigorous as those performed by principal contractors.

However, the selection of an appropriate and suitable form of procurement is only the beginning for a complete and effective implementation of management strategies. Other health and safety issues need to be considered; these issues have been identified through industry surveys and case studies as reported in the following section.

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5 Detailed description of the procurement routes can be found in Section 2.1 of the WP2/WP3 report “Comparative studies of UK and Italian refurbishment sites involving demolition activities and structural alterations” - Analysis of Health and Safety Management strategies.
4.2 Investigation of selected UK and Italian refurbishment sites

The investigation and analysis of health and safety issues to be considered when implementing health and safety management strategies for refurbishment projects required a significant number of case studies on sites involving demolition activities and structural instability problems.

The selected refurbishment sites were investigated through contact and interviews with professionals involved on those sites; these included structural engineers, general contractors and specialist demolition contractors. The study of the refurbishment sites was developed through site visits and the analysis of project documentation, method statements and health and safety plans.

The selected case studies provided good examples for the implementation of health and safety management strategies and the findings were used for the identification of those health and safety issues to be considered in the management of refurbishment sites. The main findings from the comparative study of Italian and UK refurbishment sites are:

1. The Italian interpretation of the EU directive 92/57 (interpreted in the UK with the CDM regulations) requires the Client to appoint an Execution Phase Co-ordinator. He/she has to co-ordinate and supervise the implementation of all the health and safety procedures developed in the pre-tender health and safety plan. The appointment of such a Co-ordinator provides a more efficient control of Client’s health and safety requirements for refurbishment and demolition activities.

2. The use of method statements, which are still poorly diffused in the Italian construction industry, was recognised to improve the quality of communication and information of demolition sequences and of the related safety procedures.

3. The use of foreign nationals as building workers is widely spread in the UK and Italy. Therefore communication problems and health and safety training are crucial issues for both construction industries.

4. Refurbishment sites in Italy have to deal with many logistic and archaeological issues that need to be co-ordinated with health and safety requirements. This is mainly due to the location in historical centres of many refurbishment sites. In this context the use of temporary structures (i.e. scaffolding, facade retention etc.) is particularly affected. Italian case studies provided good example of demolition and reconstruction sequences that, when accurately planned, can significantly reduce the use of temporary structural support.

5. The requirements expressed by the English and Italian Heritage proved to have a considerable effect on the development of refurbishment projects. The case studies showed how the need of preserve some elements or parts of the building under refurbishment involves substantial changes in the development of demolition methods and planning and the related health and safety procedures.

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*Detailed description of the selected refurbishment sites is included in Section 5 of the WP2/WP3 report.*
4.3 Analysis of HSE accidents investigation reports

The accident investigation reports provided by HSE inspectors showed a different scenario of refurbishment sites from what presented by the selected case studies. The reports highlighted a number of health and safety failures that caused collapses (with or without fatalities). HSE inspectors helped in the identification of the health and safety issues that, because collapses had occurred, were not obviously taken into consideration. Major findings from the study of the accident investigation reports were:

- Absence of temporary structures to support unstable elements;
- Lack of risk assessment at design stage, neglecting CDM requirements;
- Lack of any preliminary structural survey or site investigation;
- Poor planning of demolition sequences;
- Lack of demolition method statements;
- Lack of supervision while undertaking demolition activities.

The conclusion arising from HSE investigation reports further corroborated the identification of the health and safety key factors elaborated in the first stage of the research project.

4.4 Identification of key issues for health and safety management strategies

The investigation of the selected case studies, the study of the HSE accident investigation reports and the interviews with health and safety professionals led to the identification of the following key issues to be implemented in health and safety management strategies for refurbishment projects:

- Demolition design and planning
- Selection and use of plant and equipment
- Workforce pre-qualification, selection and supervision
- Communication of project requirements and H & S information
- Health and safety education and training systems

The key health and safety issues identified can be summarised as follows:

**Demolition design and planning**: demolition works need to be tackled as a part of a whole project with the proactive involvement of the Client who will have to select competent structural engineers, specialist contractor and subcontractors. Co-operation and exchange of information between all the parties involved in the project is vital to ensure high health and safety standards during site activities.

**Selection and use of plant and equipment**: due to the relatively high risk of accidents related to their use, demolition tools and equipment have to be assessed and selected for the specific use and health and safety procedures need to be developed.

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1 The report has been anonymised for the purposes of this research.
2 Detailed description of the key issues for the health & safety management strategies can be found in section 2.2 of the WP2/WP3 report “comparative studies of the UK and Italian refurbishment sites involving demolition activities and the structural alterations - Analysis of Health and Safety management strategies.”
**Workforce, pre-qualification, selection and supervision:** the findings from the research work strongly recommend that workers be assessed for their ability to understand procedures and safety instructions that are communicated to them. Workers who are employed to carry out demolition activities have to be specifically trained on each aspect of the work they are undertaking.

**Communication of health and safety information:** the case studies showed that communication is a key factor in completing a project safely. Communication must be organised at all the different levels and stages of a refurbishment project; more details are provided in section 6 of this report.

**Health and safety education and training systems:** all the key functionaries involved in a refurbishment project are required to have adequate health and safety education. The case studies provided good examples of how construction organisations are implementing and evolving their internal health and safety training systems.

### 5. Key professional roles in the health and safety management of refurbishment projects

#### 5.1 Key functionaries in refurbishment projects

The key health and safety factors and issues identified in the first part of the research work needed to be properly addressed to the specific professional figures involved in the refurbishment process. The key functionaries identified for a refurbishment project are Client, Planning Supervisor, Architect, Structural Engineer, Contractor, Demolition Contractor, Temporary Structures Co-ordinator (new role) and Workers. For each of these key figures a checklist of health and safety issues, extremely important for an effective health and safety management on refurbishment projects, was developed. The development of the checklists also identified areas where further HSE guidance is required; these areas are extension of CDM to refurbishment, education, communication, qualification, design, planning and management.

#### 5.2 Client’s key role

The research findings emphasise that Clients play a key role in setting the most appropriate health and safety management strategies. The case studies demonstrated that when the Client is involved in the health and safety management of the work he/she is procuring, and when high health and safety standards are demanded, the site is safely managed. The research work proved that Client engagement is crucial in setting and achieving high standards of health and safety management strategies. Indeed, Clients should:

- Have an overall supervision of contracts setting;
- Set up time and budgets for projects;
- Set up time to allow preliminary structural investigations to be carried out;

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*All the checklists are included in the WP4 report “Checklist of issues to consider and areas where further guidance is required”.*
Pre-qualify and select designers, contractors and specialist demolition subcontractors.

5.3 The Temporary Structures Co-ordinator

The UK case studies presented this new professional role that is able to assess and co-ordinate many of the key issues identified for refurbishment projects. The Temporary Structures Co-ordinator should be appointed by the contractor to supervise and co-ordinate the design, planning and execution of demolition works and the associated temporary works. The role of the Temporary Structures Co-ordinator is crucial for the co-ordination of all the parties involved in a structural refurbishment, therefore his/her appointment is strongly suggested for every refurbishment project involving demolition or structural alterations.

6. Communication in refurbishment projects

6.1 General findings

Communication proved to be a crucial issue for the health and safety management of refurbishment projects for a number of reasons:

➢ The communication of all the relevant information relating to the existing structure is vital for the development of an accurate structural design (that will also account temporary structures) as well as the selection of demolition methods and the preparation of demolition programmes;
➢ The transfer to the contractor of all the information gathered during preliminary investigations is fundamental for the understanding and interpretation of any structural change that can turn out during site works;
➢ Health and safety rules and instruction need to be communicated to workers to make them understand and respect health and safety standards and requirements; this is a particular challenge when foreign language workers are employed on site.

6.2 Communication levels in a refurbishment project

The research project identified three different stages across which the communication of project information and of health and safety requirements has to be organised:

➢ **First level – Client’s team**: the communication of design information and of any assumed demolition sequence developed by the structural engineer is vital for the preparation of the pre-tender health and safety plan. This may also result in modifications to parts of the design or in the implementation of specific safety procedures in the pre-construction health and safety plan.
➢ **Second level – between designer/structural engineer and contractor**: project information has to be communicated in detail in order to share the engineering knowledge acquired during the design stage. Communication between designers and contractors during design changes is also fundamental. The exchange of

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10 The full description of the three communication stages is reported in the WP2/WP3 report “Comparative studies of UK and Italian refurbishment sites involving demolition activities and structural alterations: Analysis of Health & safety management strategies.”
information has to be mutual because the contractor, through his experience and
skills, may add additional considerations to the project. If assumed demolition
sequences have been developed they have to be explained to the contractor. The
contractor may modify them adding the demolition method selected and the
related plant and equipment.

➢ Third level – contractor/subcontractor’s team: Project information has to be
communicated to the workforce and the site manager had to ensure that they
understand site rules and health and safety procedures related to the activities they
are going to undertake. Workers have also to be adequately instructed about not
taking any initiative that has not been authorised by site managers.

The case studies showed examples where project information can be better
communicated through drawing-based method statements. Instructions can be given
to workers through regular briefings with workers; because the instructions to be
given to site workers need to be clear and concise (especially to overcome language
barriers) and they have to capture the attention of the audience; drawings and pictures
are strongly suggested.

7. Conclusions and recommendations for further research

The research project investigated the key health and safety factors and management
strategies to be implemented for refurbishment projects involving demolition
activities and structural instability. Due to the peculiarity and complexity of the
activities involved, health and safety aspects have to be carefully planned; indeed
health and safety have a great influence in the design and management of
refurbishment projects. It can also be stated that these are the most influential factors
in selecting demolition methods to prevent structural collapses caused by structural
instability. Some of the main conclusions that can be drawn from the research project
include the following:

1. Prior to undertaking any demolition activity on site that may interfere with the
structural stability of the building, preliminary surveys and site investigations
have to be carried out by structural engineers as well as specialist demolition
contractors;
2. Refurbishment projects involving demolition activities require the appointment of
competent and qualified professionals who are going to implement health and
safety in the development of any stage of the project, from design to execution
phase;
3. Refurbishment projects are more likely to involve complex activities that require
the acquisition of various information related to the existing structure as well as
the integration of many health and safety aspects. Therefore there is the need for a
key figure in charge of the co-ordination of all structural information elaborated
during the design phase and of the supervision of the design of temporary works
and of the planning of demolition activities. The research project has identified
this figure as the Temporary Works Co-ordinator;
4. Clients need to be more involved in the health and safety management of the
refurbishment projects they are procuring. They have to appoint in ‘reasonable
time’ qualified engineers and specialist contractors and subcontractors; in this
context Clients who are not frequently involved in the procurement of refurbishment projects should be given more advice and guidance about their responsibilities concerning health and safety legislation;
5. The field of application of CDM regulations should be extended to smaller-sized sites, in this context many refurbishment sites would then have to apply these regulations with an increased involvement of Clients and designers;
6. Communication of project information and the Client’s health and safety requirements has to be considered a priority issue for the development of effective health and safety management strategies;
7. Health and safety education of foreign language workers is a crucial issue. New communication systems such as drawing-based method statements or the use of pictures or video for health and safety training is strongly recommended.

Following conclusions developed from the research work and case studies, further areas of research were identified:

- **Client’s role**: to investigate the role of Clients in the refurbishment process developing comparisons between occasional and experienced Clients as well as providing requisite recommendations that can be made available (i.e. through Planning Offices) to occasional Clients;
- **Communication**: to investigate current communication methods and strategies as well as the use of IT tools in the development of health and safety plans, method statements, health and safety audits on sites etc;
- **Education and training**: to investigate current construction workers training schemes and identify those educational subjects that should be improved for refurbishment/demolition works as well as making recommendations for the development of professional training schemes for personnel employed on refurbishment sites;
- **Management**: To investigate the current knowledge and usage of health and safety management tools (i.e. health and safety plans, method statements etc) by key functionaries involved in refurbishment work as well as making recommendations for the effective usage, update and management of health and safety documents on site as well as their communication to the workforce.
- **Decision support**: to develop a practical decision support system that organisations and individuals involved in refurbishment works could use to make decision in order to perform works safely as well as developing a new process model for refurbishment works, which ensures that safety considerations are taken into account from the earliest stages in the planning and design of refurbishment works.

Clearly, there is ample evidence from the foregoing that the results from this research project have been highly significant. The project team plans to build on these results by further journal publications, conference papers, presentations at industry forums, and seeking funding to undertake some of the further research areas outlined above.

For a full description of the research areas identified see WP5 report “Report on recommendations for further research”.

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References:


11. Italian Decree of the President of the Republic n.164/56 “Rules for the prevention of accidents on construction workplaces”.

12. Italian legislative decree n. 528/99 “Implementation of European directive 92/57 concerning minimum health and safety procedures on temporary and mobile sites”.

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1. Summary

The present work is the report of the working phase no.1 (WP1) of the Health and
Safety Executive and Loughborough University joint research programme “Health
and Safety in refurbishment involving demolition and structural instability”. Scope of
the report is to give evidence to health and safety factors on refurbishment sites and
how these factors have a great incidence on projects involving demolition activities
both in the UK and Italian construction industry.

Key factors have been identified and discussed through the analysis of demolition
methods and techniques together with considerations related to site-specific aspects.
The demolition process, as part of the refurbishment project, has been divided into
three phases: design, planning and execution phase. This division has facilitated the
identification and the categorisation of health and safety key factors. The final part of
report gives preliminary recommendations to clients and contractors. Such
recommendations should help them in identifying health and safety factors prior to the
start of a refurbishment site.

2. Introduction

2.1 Refurbishment in the UK and Italian construction industry.

In the last 30 years there has been a significant increase in refurbishment works both
in the UK and in the Italian construction industries. The factors that may have
influenced this increase include:

- increase in redundant and ageing buildings;
- shortage of available areas for new construction developments;
- social and technological factors making old buildings inadequate and obsolete;
- development of building standards and regulations increasing the need for
  construction refurbishment to comply with new requirements.

Italy also has a huge historical and architectural heritage, which is in need of
continual refurbishment and restoration. The refurbishment sector, in its many forms,
accounts for more than 40% of the total UK construction output. Although no official
statistics on the actual value of refurbishment output exist, this sector has increased in
the past 30 years from the 22.46% to the 43% of total construction output.

In Italy more detailed statistics are available, the data shows the increase in
refurbishment work in the past 10 years. According to the statistics provided by
CRESME (Research Centre on the Construction market) and ISTAT (Italian Statistics
Central Institute) in 1995 refurbishment accounted for the 57.5% of total construction
output, this percentage being composed of 30% of ordinary maintenance works.

In 1999, the refurbishment sector registered a 3% increase and the latest data available
shows an 11% increase in the year 2000. The total volume of refurbishment output is
composed of 60% private housing works and 40% public works. Table 1 shows the
increase of investment in the Italian construction sector.
Before investigating health and safety factors with a significant impact on refurbishment works some definitions of refurbishment in the context of this study must be provided.

Egbru (1994) analysed many definitions of refurbishment put forward by practitioners, researchers and professional institutions. Some of these definitions are listed as follows:

- **Hall (1984)**: “Refurbishment refers to the process of repair, conversion and alteration of existing buildings to permit their reuse for various specified purposes”.
- **CIOB (1987) code of estimating practice**: “The alteration of an existing building designed to improve the facilities, rearrange internal areas and/or increase the structural lifespan without changing its original function”;
- **Norman Douglas (1988), Director of Costain Construction Limited (Refurbishment division)**: “Refurbishment is a process of changing a building or indeed an area previously unusable or unsuitable, to a condition where it becomes usable at a standard acceptable to the community. It may involve substantial change of use. This also includes improvement, which is less dramatic and does not usually involve change of use. Repair and maintenance also enters into this section of the building industry, which implies the continuing keep-up of building stock to existing standards”;
- **Ian Dixon (1990), Past President of the Chartered Institute of Building (CIOB)**: “Building maintenance is that process concerned with the restoring to good condition any part of a building that is in any way defective, or non functioning. Refurbishment and the modernisation market are concerned with alteration, addition and enhancement to buildings on both small and large scale”;

Hall also provided a classification of refurbishment work into four main categories:

1. **Alteration**: work, which is carried out to change the structure of a building to meet new requirements. For instance, changing the internal layout of a building;
2. **Adaptation**: work which is carried out to accommodate a change in use of a building;
3. **Extension**: work which is carried out to increase the floor area of a building and includes both horizontal and vertical extensions;
4. **Improvement**: work, which is carried out to bring a building and its facilities up to an acceptable standard.

The Italian regulatory framework law 457/78 (Residential building standards) provides a list of definitions for construction works carried out on existing buildings: ordinary maintenance, special maintenance, restoration and conservative cure, building renovation, town-planning renovation. These are described below:

- Ordinary maintenance includes reparation, renovation and substitution of parts of building’s finishing as well as those works that are necessary to integrate or keep functioning existing plants and services.
Special maintenance includes those works and modifications to renovate and change building parts (also structural) as well as to implement services (such as toilets or heating/cooling systems) without changing volumes and surfaces of the building units and without changing their existing use.

Restoration works (i.e. consolidation works) are meant to preserve buildings and monuments and to maintain their functionality.

Renovation works are those aimed at transforming building units in other units, which can be, completely different from the previous ones. In these works new parts of the building can be added as well as new services and plants.

Town planning renovation projects are developed on a larger scale. In these works new construction can be carried out together with infrastructure as well as a re-development of the existing areas.

In the context of the present study, in which demolition activities and structural instability will be investigated, refurbishment work should be understood to involve a particular and quite complex works (it could be site and off-site based works – e.g., design works for refurbishment done off-site) related to existing buildings. Therefore refurbishment works will involve improvement, adaptation, upgrading, rehabilitation, renovation, restoration and any extraordinary or unplanned maintenance. In this definition repair works and ordinary maintenance (e.g. cleaning, painting, decorating etc…), carried out on a regular basis, are not included.

### 2.2 Accident statistics

Although neither the UK nor Italy differentiates between new construction and refurbishment accident data, statistics suggest that refurbishment, in its different interpretations, accounts for a substantial amount of injuries and fatal accidents [HSE, 1988; CIRIA, 1994]. There appears to be little or no empirical and generally agreed data currently available. There, however, exist some anecdotal evidence.

The Italian Accident Statistics Body (INAIL) is currently developing a new data collection system in order to separate accidents that occur on new construction sites from those that occur during refurbishment works. Such collection can be possible through the link between the accident reported to local authorities and the planning
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permission of the site where the accident happened. This authorisation has, in fact, to show the nature of the construction site and the type of work performed (new construction or refurbishment).

**2.3 Refurbishment and demolition**

According to the definition of refurbishment provided in Section 1.1, demolition works can be considered among the most important activities to be carried out on site. Demolition activities are mainly related to projects where structural alterations of the existing building are required. These alterations could be very different depending on the size of refurbishment works. Some examples are given in the following list:

- total façade alterations;
- total removal of structural elements (columns, beams, slabs, walls, etc.);
- partial demolition of the building shell to build extensions;
- construction or enlargement of new openings.

Demolition works are among the most dangerous operations to be performed on site due to the high level of risk the workers are exposed to; a more detailed study of risks related to demolition activities is given in the following sections. The present study will particularly focus on partial demolition.

Partial demolition involves carrying out works only on portions of the structure and maintaining structural stability for all the remaining parts during and after execution. Such structural stability can be provided with different methods (adequate structural analysis, temporary support structures, proper demolition method, schedule and equipment, etc.). This will be further discussed in Section 3. Partial demolition also involves other health and safety risk related to site organisation, which have to be properly assessed while planning refurbishment works.

Whilst total demolition can be mainly carried out by mechanical equipment, partial demolition works require a larger number of workers employed on site especially for demolition by hand activities. A structural survey studying the interaction between structural elements to be removed and those remaining has to be carefully developed to avoid premature or unplanned collapse.

Unfortunately more accidents and fatalities occur during partial demolition than during total demolition works especially while carrying out small demolition activities. This can be also put down to the appointment of non-specialist contractors and to the lack of co-ordination and supervision of all the other activities conducted at the same time.

Demolition works can be planned for buildings that do not need to be entirely refurbished; interaction between site works and the presence of people occupying such buildings needs to be investigated as well. Because accidents during demolition works are mainly caused by partial or total collapses this study will focus on the identification of those key factors to be addressed to prevent structural instability and on the possible causes of structural collapses.
3. Demolition in refurbishment projects

3.1 Demolition methods and techniques

While investigating partial demolition in refurbishment projects, demolition methods, techniques and equipment must be identified and assessed. Depending on the structural elements to be removed or demolished and applying the principles of structural demolition as reported in BS 6187 - Code of practice for demolition structural demolition methods can be identified as follows:

1. Progressive demolition;
2. Deliberate collapse mechanism;

Progressive demolition should be considered to be the controlled removal of sections of the structure, whilst retaining the stability of the remaining part and avoiding collapse of the whole part of the building to be demolished (BS 6187, 2000). Therefore the key structural elements of the construction should be clearly identified as well as demolition sequence. The Italian safety legislation requires that the contractor develop a site-specific demolition schedule prior to the opening of the site. As reported in the code of practice, progressive demolition is the most commonly used type of structural demolition. This method seems to be particularly useful in confined and restricted areas.

Deliberate collapse mechanism should be considered to be the ‘removal of key structural members to cause complete collapse of the whole or part of the building or structure’ (BS 6187, 2000). When used in total demolition this technique should be employed on «detached, isolated, reasonably level sites». This requires sufficient space in order to move and place equipment and personnel at a safe distance. Before carrying out any partial demolition works, a structural survey needs to be undertaken to ensure that no structural instability will arise during demolition. Consequently avoiding any unplanned collapse of the structure in areas where workers are present. Infact, among the most common causes of structural collapses it is possible to identify for example: activity induced, load induced (e.g., debris localised overloading), spontaneous collapse, remote activity and machinery impact.

The deliberate removal of elements is a demolition method used to remove selected parts of the structure by dismantling or deconstruction. Prior to the removal of any parts of the structure any potential instability or collapses must be assessed. Focusing on partial demolition the health and safety risk assessment will be developed through the analysis of:

- Demolition method and techniques;
- Structural elements to be removed and their constituent materials;
- Equipment and tools.

While studying partial demolition in the refurbishment of old buildings, structural elements are more likely to be composed of timber, concrete and bricks. Depending on the size, the type and materials of structural elements and on the extent of demolition works, proper equipment and tools have to be selected. When demolishing
structural elements, such as beams, slabs or walls, vibrations induced by mechanical equipment could be dangerous for the integrity of the whole structure and of adjacent constructions. If the structural survey assesses that the structure may show instability or damage after being exposed to vibration demolition –by-hand method is strongly recommended. Use of manual tools as well as electrical or pneumatic hammers is recommended in confined spaces and for internal demolition works due to the lack of space and of safe areas.

Demolition techniques such as demolition ball, demolition by explosives, blasting and bursting are mainly related to total demolition, therefore they will not be discussed in this section.

Earthwork machines with hydraulic attachments are frequently used when required by the size of demolition works and when permitted by structural conditions of the remaining parts of the structure. Excavators of different sizes and skid-steer loaders are among the most commonly used type of demolition machines. They are generally used in the demolition of steel, concrete and masonry buildings.

Hydraulic attachments have to be selected depending on the materials that are required to be demolished. The most common hydraulic attachments are:

- Pusher arm;
- Impact hammer: pneumatically or hydraulically operated;
- Hydraulic shears;
- Pulverizer;
- Demolition pole;
- Grapple.

Through the study of demolition methods it is possible to develop a preliminary risk assessment that will identify those general risks involved in demolition operations. This general risk assessment will need to be further developed on the site-specific context to allow an effective development of safety procedures.

### 3.2 Health and Safety risks in demolition works

Most of the health and safety risks in demolition activities are related to an unplanned collapse of the structure; at the same time the incorrect use of a demolition tool can cause injuries as well as an unsafe site.

Through the analysis of accident statistics it is possible to notice that a reported accident such as «trapped by something collapsing or overturning» can be related to the collapse of structural parts or uncontrolled discharge of debris. Using demolition machines involves risks such as being struck by moving vehicle or objects (e.g. excavator’s attachments) as well as contact with moving machinery or material being machined.

Structures partially demolished should be bounded and danger signals should be provided to prevent workers from getting into dangerous areas; Falling from height (e.g. falling from a floor partially demolished) is among the most frequent kind of accident encountered (HSE, 1988). Risks related to explosions should be assessed
when plants and services are still in use and therefore a temporary suspension of gas and/or electricity supply should be required during the execution of demolition activities. Even if the number of risks related to demolition activities seems to be relatively small, there are many factors that when not properly addressed may cause a serious injury or fatality. Such key factors will be investigated in detail in the following section.

**Key factors associated with the high level of health and safety incidence in refurbishment**

**4.1 General**

Health and safety have a great influence in the design and the management of refurbishment projects, especially those involving demolition activities. It can be stated that those are the most influential factors in selecting demolition methods to avoid structural instability and prevent structural collapses. The most important question this study needs to focus on is “why do collapses happen”? Structural collapses have to be identified as events with predictable and unpredictable causes. Unpredictable causes are generally related to natural and catastrophic events such as earthquakes, avalanches, floods, etc… On the contrary predictable causes can be determined, controlled, reduced or removed.

Causes of collapse associated with demolition activities can be identified through the different phases of the building process: design, construction, use and refurbishment. The building process for a new construction project is quite similar in its scheme to a refurbishment project where a design and an execution phase can be clearly identified. At the same time, the approach to demolition works should be the same as the whole project: a design phase needs to be developed and an execution phase needs to be planned. Therefore, demolition phases should be considered as a sub-project where design, planning and execution phases must be carefully studied and assessed. When developing a study of these phases it is possible to determine possible causes for structural instability and therefore provide, in such phases, different methods and tools to prevent collapses.

**4.2 Demolition design**

Prior to carrying out any refurbishment works involving structural alterations a detailed and complete structural survey needs to be prepared; to develop this survey the following information needs to be available:

- Original structural design documents (drawings, structural calculations, etc…);
- Report of all structural alterations carried out on the construction in the past;
- Material samples taken form the construction to test real structural conditions;

Upgrade of buildings and change of use may increase the loads on the ground where the structure is based. This can lead to subsidence of the foundations thereby compromising the stability of the whole building. An appropriate geotechnical survey is therefore required to identify whether geotechnical processes are needed or not (underpinning, pile foundations etc.).
The purpose of this survey is to determine the condition of the framing, floors and walls as well as weak structural elements so that measures can be taken to prevent the premature collapse of any portion of the structure. The interruption of a load path, the effect of gravity and the inability of the remaining structure to support any force redistribution may cause structural instability and therefore lead to an unplanned collapse. Any adjacent structure(s) or improvements should be similarly checked. The survey should indicate if the structure to be demolished has been damaged by fire, flood, explosion or some other cause. This can normally be determined after removing pavements and finishing from the structure.

When all the information about the structure is available, demolition techniques can be assessed and schedules developed accordingly. The sequence of demolition phases will be determined in order to maintain the structural stability of all remaining parts at all times. Key structural elements of the remaining parts do not have to be demolished or damaged by demolition activities. If the layout of the refurbishment project requires the demolition of any key structural elements (e.g., before reconstruction of a new part of the structure), temporary support systems should be investigated, designed and used.

When designing demolition activities it has to be recognised that collapses may be caused by activity induced during the execution of demolition works and not only by the removal of key structural elements. Therefore appropriate plant and equipment have to be selected to avoid excessive loads on the remaining parts of the construction (e.g., air compressor for pneumatic hammer on weak floors or mini-excavator on a weak structure, etc.)

4.3 Demolition planning

As already mentioned unplanned collapses are not only determined by an unsafe sequence of demolition activities. Other factors may contribute to structural collapses in a refurbishment work, many of them being related to site organisation. The British Standard code of practice for demolition (BS 6187, 2000) in clause 7 gives clear instructions about the «knowledge of the site». This information can be obtained either form a desk study or from a site survey. A desk study will provide some information about site conditions that may effect structural integrity during demolition activities such as:

- ground conditions (water table, ground type, sink holes, etc.);
- location and type of services, above and below ground;
- traffic condition and site access;
- extent of buried features or above ground structures.

The investigation on site should extend the knowledge gained during the desk study and provide a more accurate understanding of the existing conditions of the construction compared to what is identified in drawings and documents. Such survey will point out any differences and alterations that may have taken place and if these changes have been reported within the building files. Site investigation plays an
important role in the development of a structural design survey, as well as in the planning of all demolition activities.

After the selection of methods and plant for demolition, a work schedule has to be developed taking into account site-specific conditions. When programming and developing a schedule for demolition activity during the construction, demolition activities should not be concentrated simultaneously. This avoids exposing the structure to excessive amount of loads or vibrations as well as problems caused by too many workers in a limited area. Noise production should be assessed as well; noise assessment should take into consideration if people are occupying the facility being refurbished or any adjacent buildings. Noise emission levels should be checked as well for the health of site workers. Such assessments may give cause for the work schedule to be modified in order to avoid the concentration of demolition activities or to avoid their execution during certain hours of the day. This can cause an extension in the duration of refurbishment activities and therefore must be taken into account while managing the whole project.

### 4.4 Demolition execution

Provided all the structural and site surveys have been properly developed, the demolition methods have to be correctly implemented. To control demolition, method execution supervision needs to be provided and managed. Prior to setting up a supervision activity through inspectors and safety professionals, the client must select contractors and subcontractors for demolition activities. The client should limit the number of subcontractors working on site to allow an easier control over subcontractors employed on site at any time. At the same time the client should be able to pre-qualify and therefore select contractors and subcontractors on their competencies and experience in demolition works.

On the other hand, contractors have to respect demolition methods assessment and the site-specific demolition health and safety plan procedures. A continual workforce control activity must be carried out by contractors' demolition supervisor to stop workers executing unplanned activities. Workers should be informed of the risk arising from non-compliance with safety instructions; this may be carried out through training courses and toolbox talks.

Language barriers can be a serious problem especially in the construction industry where almost all the instructions, as well as emergency advice, are given verbally. Language problem also extends to the fact that refurbishment works seem to attract many nationals who move in and out of refurbishment and jobbing works because of its relatively short duration. This exacerbates the language challenges. Such barriers can be partially overcome through the use of illustrated safety instruction and signals.

### 5. The significance and impact of health and safety incidence on refurbishment projects

Refurbishment projects are likely to be more difficult to manage than new construction works. One of the main reasons for this is the large number of updates
and adjustments (work methods, schedules, facilities, etc…) needed due to the discoveries made while carrying on site works. This can be frequently put down to inappropriate surveys developed at the design phase. Nevertheless, site experience shows that full project information about the building being refurbished, such as structural material conditions can be available only during work execution. This lack of project and planning information influences the whole site organisation with an underestimation of important factors as:

- Site desk study and investigation;
- Contractors and subcontractors pre-qualification and selection;
- Supervision of refurbishment works.

After the analysis of demolition phases, from design to execution stage, the key factors reported in the flow chart below should be assessed and implemented prior to carrying out any demolition works:

With the increasing number of refurbishment projects being undertaken in the UK and in Italy, these factors, as well as those indicated in Section 3, if not properly addressed and checked, could impact on the progress of a refurbishment project. This impact on refurbishment works could affect different aspects of the development of the project, most often these being related to health and safety issues. The lack of work scheduling, poor site organisation as well as little co-ordination or supervision of activities is among the main causes of accidents. At the same time the works may not be completed in compliance with project specifications.

The effect of an unplanned collapse impacts on workers' safety as well as the building being refurbished. Greater priority must be given to preventing accidents on site. The effects of an accident can impact upon the client, the contractor and their construction businesses in the following ways:
• Productivity and efficiency of the workforce can be affected as a result of injuries and people leaving work on sick leaves;
• Project profitability could decrease due to delays in completing the job or due to structural damages caused by unplanned collapses. At the same time damage caused to adjacent properties need to be compensated by the client or the contractor depending on their responsibility for the damage;
• The impact that refurbishment works involving demolition activities may have on the environment should be assessed as well. Waste treatment, re-use and recycle of debris, hazardous materials disposal should be planned as carefully as demolition sequence. The impact on the environment, when such factors are not properly addressed could be so negative that it may affect the overall benefits achieved with a refurbishment project.

6. Issues on prevention and control of health and safety incidence on refurbishment projects

The high level of health and safety incidence on refurbishment sites involving partial demolition activities can be attributed to some key factors as already investigated in Section 3. These key factors are related to the design phase of refurbishment projects as well as to the execution phase and they involve both the Client and the contractor. The Client is more involved in the design phase therefore his supervision is very important to ensure that the health and safety key factors are properly addressed and assessed. The activity and the supervision of the Client could be expressed in the following actions:

• to appoint a competent engineer to develop detailed structural survey on the construction to be refurbished;
• to appoint a competent planning supervisor for the control and supervision of all the safety aspects on site;
• to provide sufficient time in the project development to get all the necessary information for the structural survey, desk study and site investigations;
• to assess a reasonable time schedule to complete refurbishment works in order to ensure that the activities are performed in safe conditions;
• to pre-qualify and select specialist contractors with good experience and competence in refurbishment works;
• to ensure that project documentation is updated and/or modified following discoveries that may be made while working on the structure.

When contractors are selected to carry out demolition works they should obtain from the Client all the information developed during the design and planning phase: for example the structural survey, the demolition method and sequence. The Contractor’s experience will be useful in integrating any safety procedures to the project safety documentation developed by structural and safety engineers. During the execution phase contractors and subcontractors will have to contribute to effective safety management ensuring the following activities:

• providing appropriate information and training related to health and safety hazards during demolition works;
7. Conclusion and recommendations

The first stage of this study has focused on identifying those key factors associated with the high level of health and safety incidents on refurbishment projects. Refurbishment works involving partial demolition have been specifically investigated. In this sector many accidents are related to structural collapse therefore the study has concentrated on analysing the causes of structural instability that may bring about the collapse of the whole or part of the building or of any adjacent structures. Identified causes have been categorised depending on which phase of the building process they could be attributed to.

At the design phase of demolition works, factors, which need to be properly assessed, are related to knowledge of the structure and of the site. A detailed study of all the modifications of load paths must be developed in order to guarantee the stability of the remaining part of the structure during all the execution phases. If stability cannot be maintained, temporary structures should be designed and installed.

The selection of the demolition method will, therefore, be based on the need to maintain the structural integrity of any remaining parts or adjacent constructions. While work progresses, contractors and subcontractors have to supervise the correct implementation of the chosen method of demolition arising from any assessment developed during the design and the planning phase. Meanwhile information and training must be provided to all workers and any discoveries of different structural conditions from those assessed during planning phase must be promptly communicated to the Client.

At this stage of the study, preliminary recommendations can be developed and addressed both to the Client (as well as the team of professionals involving designers and Planning supervisor) and to the contractor/subcontractor:
• Clients should supervise the activity of the engineers in charge of developing structural analysis and calculations. Where the Client’s competency is limited, specialist demolition engineers should be appointed and they should be able to assess all those safety factors in order to avoid structural collapses and therefore accidents on site.
• The client should select specialist contractors with demolition experiences and this can be easily done referring to demolition contractors’ associations.
• While developing contract clauses the client should also limit the level of subcontracting to be able to control the qualification and selection of subcontractors on site.
• Contractors and subcontractors have to respect the demolition sequence and the safety instructions reported in demolition method statements. The supervision and control activity is needed during the execution phase to avoid unplanned activities undertaken by the workforce.

Health and safety management strategies have to be accurately developed and selected on the basis of the key factors investigated as reported here. The current use of such strategies is going to be the specific objective of the second stage of the present study.

References

6. Italian Decree of the President of the Republic n.164/56 “Rules for the prevention of accidents on construction workplaces”.
7. Italian legislative decree n. 528/99 “Implementation of European directive 92/57 concerning minimum health and safety procedures on temporary and mobile sites”.
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APPENDIX 2

WP2 – WP3 Preliminary Report

Comparative studies of UK and Italian refurbishment sites involving demolition activities and structural alterations

“Analysis of Health and Safety management strategies”

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1. Introduction

The present work is the preliminary report of the working phases 2 and 3 (WP2 and WP3) of the Health and Safety Executive and Loughborough University joint research project on "Health and Safety in refurbishment involving demolition and structural instability".

The scope of this preliminary report is to give evidence on what has been uncovered as part of the on-going investigation on health & safety management strategies in current usage for refurbishment work involving demolition activities. Comparative studies on refurbishment projects involving demolition activities, both in the UK and Italian construction industries are documented. After the identification of key factors, through the analysis of demolition methods and techniques, the research activity progressed to select refurbishment sites to verify and document such key factors in current practice. The selection of the case studies was based on similarities between each site as well as specific differences. All the sites, in the UK and in Italy, are located in central areas in order to study the relationship between site organisation, especially of temporary works, and the surrounding environment.

The selected sites present particular structural instability situations requiring specific temporary structures and demolition sequences. The size of the projects used as case studies varies and includes large and small-medium project sites. Most of the sites involved both specialist and general building demolition contractors.

A brief description of the case studies is presented in this report. The report will be incorporated into the final WP2 and WP3 report at the end of the site investigations, analysis of the refurbishment and demolition activities, and the appraisal of related management strategies for refurbishment work.

2. Case Study 1 – Asprey and Garrad building, New Bond Street, London, UK

Case study provided by: Alan Baxter and Associates
Contacts: Robert Bowles, David Johncox

Description
The site will involve the structural refurbishment and the upgrade of the internal layout of the buildings originally occupied by the Asprey and Garrad jeweller shop. Interest in the refurbishment site is of the entire property, which includes six buildings situated between Albemarle Street, Grafton Street and New Bond Street (Fig. 1, Fig. 2, Fig. 3).

The major refurbishment works of interest include the portion of the property facing New Bond Street. Important demolition activities will be undertaken in this part of the building, which has been affected by substantial structural changes carried out in the 20th century and detailed in the investigation report developed by Alan Baxter’s structural engineers.
The most important structural alteration has affected the first two floors of the building on New Bond street. To create an open space for the jewellery all the beams and the biggest columns were removed leaving only few slender pillars. The structural behaviour of this part of the property and the possible changes during demolition works are being studied before the start of any refurbishment work.

The building, due to its age and location, is listed and English Heritage requires that the facade has to be maintained; therefore, structural façade retention will be necessary during the structural refurbishment. In the core of the six buildings, the architect has designed a courtyard covered by a glass roof. The construction of this courtyard will involve substantial demolition of the internal core demanding internal façade retention for some parts of the structure.

Management scheme
Initially the procurement scheme was a construction management scheme. The refurbishment works were divided into different packages of construction works to be awarded to different specialist contractors.

Alan Baxter engineers are still completing parts of the design phase; structural and demolition designs are ready for the execution phase.
The construction management scheme was then changed into a general contractor scheme (traditional form of contracting). The general contracting company has already been appointed.

**Project duration**
The buildings and the shop were evacuated in the middle of May 2002. Planning permission and English Heritage approval are due in the beginning of June 2002. The main contractor is already in the property and has started to install all the site’s facilities. Demolition works should start at the beginning of July 2002. The refurbishment has to be completed for the reopening of the jewellery shop in December 2003.

![Fig.3 – View of Asprey’s building from Grafton Street](image)

**Elements of interest**
This case study has been selected for the following reasons:

1. Site location: downtown London in a commercial area with narrow and busy road bounding the buildings under refurbishment.

2. Peculiarity of the structural problems caused by previous alterations to be taken into consideration in the design phase of the project.

3. Peculiarity of the temporary works to be used during the structural refurbishment: internal and external façade retention and strengthening of the horizontal structures due to the lack of vertical support caused by the past removal of all the principal columns.

4. Interesting way of developing demolition method statements adopted by the structural engineers: such method statements are provided with drawings that
illustrate how works should be carried out (Fig. 4). All the information included in these statements are based on the preliminary research developed on the original construction and all the subsequent alterations.

5. Experienced engineering consultancy: a large proportion of Alan Baxter’s working output involves refurbishment projects and at the moment they are developing an interest in historic buildings and conservation issues. They have consolidated procedures to tackle refurbishment projects based on the most possible accurate preliminary researches to investigate original design and construction as well as all the alterations that can be observed and understood before the site commences.

Fig.4 – Part of an illustrated Sequence of construction developed by Alan Baxter and Associates.

3. Case Study 2 – Halkin Arcades, Motcomb Street, London, UK
Case study provided by: Bovis Lend Lease
Contacts: Will Taylor, Peter Fielding

Description
The building selected for the second case study is located in a residential and commercial area between Sloan Square and Belgrave Square in the centre of London.

The refurbishment site involves the change of use of a four-storey commercial building into a food hall with offices. The building is characterised by two atriums that cut the construction crosswise for its whole height (this is why it is called Halkin Arcade). The structure of the underground and ground floor has to be completely removed to allow the realisation of two open spaces. The open space on the underground floor will be used for storage while the ground floor will be entirely occupied by a supermarket.
The removal of the lower part of the structure has required the preparation of temporary works to retain the upper part of the construction during all demolition activities. The temporary works structures have been preliminarily designed by the client’s structural engineer and subsequently developed by the contractor’s temporary structures engineer. The temporary works consist of two structural frames located at the basement of the construction. The length of these frames is equal to the cross section of the building and their height is equal to the heights of the underground and ground floor together. At the top of these frames are several needle beams that are inserted into the vertical walls to support the upper vertical structures. Many parts of the frames are fabricated off-site. Other steel works were welded into position to suit the actual conditions on site.

A suspension system has been used to sustain the horizontal structure that is composed of three floors on the external sides of the two atriums. The use of internal temporary works avoided the erection of façade retention structures on the roads, in the front and at the back of the building (see Fig. 5).

![Fig.5 – Façade scaffolding: view from Motcomb street.](image)

The presence of two masonry chimneys has been of great concern for the contractor’s structural engineers. The chimneys were offering partial support to the roof structure even if they cannot be considered structural elements themselves. These chimneys are also based on two hollow ovens located in the underground floor (one of the chimneys was also eccentrically on its foundation). The contractor decided to prop the ovens and to consolidate the chimneys prior to the start of any demolition work in order to prevent any structural damage to the chimneys and the roof structure.
Part of the structure of the internal floors cannot be demolished due to restrictions imposed by English Heritage. These floors will be supported by the suspension system mentioned earlier. Details of the support structures are shown on Figs 6 and 7.

![Fig.6 - Suspension system used to retain intermediate floors.](image)

![Fig.7 - Steel frames used to support vertical walls and located on the underground basement.](image)

**Management scheme**

Bovis Lend Lease manages the project through a construction management scheme. They have selected specialist contractors for construction and demolition works. They will select other specialist contractors as the refurbishment project progresses. Bovis has a temporary works department that is in charge of the study, design, and execution supervision of all temporary structures.

A temporary structures’ co-ordinator, or supervisor, is appointed on each site. This role is akin to that of the site manager. The site manager and all the representatives of the specialist contractors on and off site have to report to the Bovis project manager.
prior to undertaking any activity. The project manager checks all the sequences of the demolition activities before issuing the approval to undertake parts of demolition works. Figure 8 illustrates the temporary structures on the project.

![Fig.8 – Drawing of the steel frame supporting the walls of the west atrium.](image)

**Project duration**
The erection of the temporary frames started at the end of April and the demolition works in the basement will be carried out from the end of May 2002 until the end of June 2002. All demolition activities should be completed by the end of the summer 2002. The refurbishment project has to be completed by autumn 2003.

**Elements of interest**
This case study has been selected for the following reasons:

1. Site location: downtown London in a commercial area with narrow and busy road bounding the buildings under refurbishment.

2. Peculiarity of the structural problems: presence of structures, e.g. chimneys that require accurate studies and precautionary measures to avoid unplanned collapses.

3. Peculiarity of the temporary works to be used during the structural refurbishment: vertical temporary works specifically designed for this site and suspension systems to hold the horizontal structures in order to disengage the floors from the structural walls that have to be demolished.

4. Management system that includes professional figures specifically tailored for refurbishment sites such as the temporary works’ co-ordinator.

5. Experienced contractor for refurbishment sites: a large proportion of Bovis Lend Lease’s working output involves refurbishment project.
Case Study 3 – Residential building, via Gorani, Milano, Italy
Case study provided by: Minotti Costruzioni
Contacts: Massimo Minotti (project manager)

Description
The building chosen as an Italian case study for the research is located in the heart of the Milan historical centre close to the financial district and to the Stock Exchange building. The construction is four storeys high and the interior of the building needs to be completely demolished but keeping the façade intact due to Historical Heritage requirements.

After demolition works the building will be entirely reconstructed and used as a private dwelling. It was not possible to find any project description or design documentation about this house. No information about past refurbishment works has been found yet. This area was seriously damaged by the 1943-1945 World War 2 bomb attacks; therefore it is possible that this house have been damaged as well.

It is clear that the overall structure is seriously compromised. To avoid structural collapses during demolition activities the whole structure has been secured with a support system composed of shores and props (see Figs. 9 & 10).

Some parts of the internal pavements have already collapsed requiring protective devices around the openings left in the floors and a structural engineer appointed by the contractor has developed a structural survey.

Due to a two-storey elevation added at the beginning of the last century the lower masonry structure has been considerably overloaded. In fact the structure of the top floors is made of concrete floors and columns. This has increased the loads on the masonry walls underneath. This situation has required a particular attention in developing the demolition sequence and the activities on the top floors will be carried out by hand demolition only.
The building is situated between two other buildings with common division walls. These adjacent buildings have been propped and supported with structural scaffolds to retain the dividing walls when they become disengaged from the horizontal structures after their demolition (see Fig. 11).

**Management scheme**

The client (who is the property’s owner) appointed a principal building contractor through a private treaty. The main contractor has selected specialist subcontractors for some groups of activities. For demolition works, the main contractor has appointed a specialist demolition contractor that is frequently appointed for this kind of project.

This project is under the “Italian CDM” regulation (d.Lgs. 494/96); therefore the following personnel are involved on site:
1. Site manager: appointed by the main contractor. The site manager is always on site.

2. Technical manager: the main representative of the main contractor who gives the instructions to the site manager. The technical manager is not always on site because he could be in charge of several sites.

3. Execution phase safety co-ordinator: appointed by the client. He is charged with the control of the observance of the procedures included in the client’s Health and Safety plan and of the completeness of the contractor’s Health and Safety Plan (the so-called Operating Safety Plan).

**Project duration**

Demolition activities started at the beginning of May and should finish at the end of June. The construction of the new building should be finished by the end of 2003.

**Elements of interest**

This case study has been selected for the following aspects:

1. Site location: central Milan in the old medieval area with narrow and busy roads around.

2. Peculiarity of the structural problems: presence of structures seriously compromised by previous collapses that require accurate studies and precautionary measures to avoid premature collapses during demolition activities.

3. Peculiarity of the site’s organisation: the site is adjacent to another refurbishment site, therefore internal viability and site facilities have to be organised in order not to create dangerous interference.

4. Management system that includes professional figures specifically tailored for Italian refurbishment sites.

5. Experienced contractor for refurbishment sites: a large proportion of Minotti Costruzioni working output involves refurbishment project.

5. **Case Study 4 – Residential building, via Donizetti, Milano, Italy**

Case study provided by: Lomacci Engineering

Contacts: Gherardo Lomacci (Works Manager and Safety co-ordinator)

**Description**

The building chosen as the second Italian case study was bought by a new owner who decided to undertake major refurbishment works. This house is located in central Milan in front of a narrow one-way road. Being a listed building the refurbishment project only included internal structural alterations and lay-out changes without any works to the facades. Only cleaning and conservation works were allowed on the facades. The construction was originally divided into four flats, the new owner
decided to start the refurbishment works to turn the building into a single five-storey house serviced by a small elevator.

The condition of the old structure suggested the removal of all internal vertical and horizontal elements composed of wooden floors and masonry walls. The project included the construction of a new steel structure composed of steel columns and beams with concrete floors on corrugated irons. A structural survey was conducted on the construction prior to completing the design phase to understand the structural behaviour of the building that had a two-storey elevation in the 1950s.

The survey revealed the need for reinforcement on the foundations and on the vertical structure in order to be able to support the new load paths deriving from the steel and concrete structure. The foundations were underpinned in different sections prior to beginning any demolition activity. The Works Manager and the Planning Supervisor carefully planned the demolition sequence in order not to leave the structural external walls unbonded after the removal of the internal elements structural.

To leave the construction in conditions of structural stability while performing the demolition activities, it was decided to remove the internal structure floor by floor. The second and fourth floors were removed and the new steel structures were placed into position before proceeding to the demolition of the other floors (see Fig. 12). With this sequence the external walls were all bound together with a global structural stability for the whole construction without using any façade retention system.

**Management scheme**

The client and the designer (who was also the Works Manager and the Planning Supervisor) selected the main contractor through a private treaty. The contractor could rely on the demolition specialist workforce for the demolition phases. Specialist subcontractors were used for plants and finishing.

**Project duration**

The refurbishment started in April 2001 and will be completed for the beginning of July 2002. The demolition works were carried out from May 2001 through to October 2001.
**Elements of interest**

This case study has been selected for the following aspects:

1. **Site location**: Central Milan on a narrow and busy one-way road.

2. **Peculiarity of the structural problems**: presence of structures weakened by previous elevations that require accurate studies and precautionary measures to avoid premature collapses during demolition activities.

3. **Peculiarity of the temporary works** to be used during demolition activities and structural re-construction: locally reinforced elements and demolition sequence developed to avoid facade retention systems.

4. **Management system** that includes professional figures specifically tailored for Italian refurbishment sites.

**6. Summary**

This report has presented the preliminary work on case studies of refurbishment works involving demolition and structural instability. Four cases have been briefly presented with their principal features highlighted. Detailed studies of the work and management regimes on these sites are ongoing and will be included in the detailed report on WP2 and WP3. From the preliminary studies undertaken so far, it is evident that Health and Safety are of paramount importance on refurbishment projects. This appears to be recognised by the project teams on the case study projects. However, the strategies adopted to manage Health and Safety vary from one project to another, depending on a number of factors. These will be discussed in detail in the next report.
Appendix 3
WP2 / WP3 Report

Comparative studies of UK and Italian refurbishment sites involving demolition activities and structural alterations

“Analysis of Health and Safety management strategies”

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1. Summary

This report covers work packages 2 and 3 (WP2/WP3) of the Health and Safety Executive-funded research project at Loughborough University on "Health and Safety in Refurbishment Involving Demolition and Structural Instability".

The aim of this report is to give evidence on what has been uncovered as part of the on-going investigation on health & safety management strategies in current usage for refurbishment work involving demolition activities. Comparative studies on refurbishment projects involving demolition activities, both in the UK and Italian construction industries are documented. After the identification of key factors, through the analysis of demolition methods and techniques, the research activity progressed to select refurbishment sites to verify and document such key factors in current practice.

To develop the analysis of current management strategies a study of current procurement routes in refurbishment projects was investigated; a description of the main professional roles involved in the design, management and execution of a refurbishment project has also been included. The investigation of current management strategies was followed by an analysis of health and safety key issues that need to be considered and assessed both at design and at execution phase.

The selection of the case studies was based on similarities between each site as well as specific differences. All the sites, in the UK and in Italy, are located in central areas in order to study the relations between site organisation, especially of temporary works, and the surrounding environment.

The selected sites present particular structural instability situations requiring specific temporary structures and demolition sequences. The sizes of the projects vary. They include large and small-medium project sites. Most of the sites involved both specialist and general building demolition contractors.

The final part of the report gives preliminary recommendations to clients, designers and contractors. Such recommendations should help them in implementing health and safety management strategy to supervise and execute refurbishment projects safely.

2. Introduction

2.2 Identification of key health and safety factors in refurbishment processes

In the previous working phase report consideration was given to the health and safety factors on refurbishment sites and how these factors impact upon projects involving demolition activities both in the UK and Italian construction industry. Health and safety have a great influence in the design and management of refurbishment projects; it can also be asserted that those are the most influential factors in selecting demolition methods to prevent structural collapses caused by structural instability.
Most of the health and safety risks in demolition activities are related to an unplanned collapse of the structure; at the same time the incorrect use of a demolition tool can cause injuries as well as an unsafe site.

Key factors were identified and discussed through the analysis of demolition methods and techniques considering site-specific aspects. The identification of key health and safety factors was facilitated through the division of the demolition process into three parts: design, planning and execution phase. The development of a detailed study of these three phases allowed the identification of possible causes for structural instability and the subsequent selection of different methods and tools to prevent collapses.

Key health and safety factors in a demolition process were identified as below and were classified in relation to each demolition phase and to the professional figures involved in the demolition process (see Table 1).

<table>
<thead>
<tr>
<th>Demolition Phase</th>
<th>Key factors</th>
</tr>
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| **Design**       | • Structural knowledge of the structure;  
|                  | • Structural knowledge of any adjacent construction;  
|                  | • Demolition equipment and methods selection; |
| **Planning**     | • Site knowledge;  
|                  | • Health and Safety risk assessment;  
|                  | • Development of safe sequences of demolition activities;  
|                  | • Limitation of the level of subcontracting;  
|                  | • Pre-qualification and selection of specialist contractors; |
| **Execution**    | • Workforce supervision;  
|                  | • Control of method statements implementation;  
|                  | • Communication of unplanned discoveries;  
|                  | • Safety information and training selection. |

Once these key factors have been identified, they need to be properly tackled before commencing demolition work. Management strategies for addressing these key factors had to be investigated.

### 2.2 Investigation of current management strategies in refurbishment projects

Refurbishment projects are likely to be more difficult to manage than new construction. This is due to many reasons: large number of updates and adjustments, the need to take into consideration the existing building and its structural behaviour etc. The key health and safety factors identified can be properly assessed if associated with a proper health and safety management strategy applied specifically on refurbishment projects. To understand the connections between such key factors and an appropriate management strategy an investigation of current procurement routes in refurbishment projects was necessary.
Management strategies can be quite different depending on the specific project, its size and context, activities involved and health and safety issues. Small refurbishment projects with no specialist refurbishment, or demolition contractors are more likely to have the poorest practices as well as the highest number of accidents. A simple, but still effective, health and safety strategy could be applied to those sites.

The selection of an appropriate and suitable procurement route is only the first step to implement an effective management strategy; other health and safety issues need to be considered such as:

- Demolition design and planning
- Selection and use of plant and equipment
- Workforce pre-qualification, selection and supervision
- Communication of project requirements and H & S information
- Health and safety education and training systems

For all these issues a detailed description will be provided. In addition, the issues that are worthy of note for clients and contractors in managing and executing a refurbishment project safely will be documented.

2.3 Investigation of selected refurbishment sites

In order to investigate and analyse key health and safety issues to be implemented in refurbishment sites’ management strategies it was necessary to select a significant number of case studies. The case studies had to be refurbishment sites involving demolition activities and structural instability problems. Sites were selected both in the UK and in Italy to be able to compare the UK and Italian refurbishment sector as already developed in the first stage of the research programme.

Case studies were studied analysing all the refurbishment and demolition process from design and planning to execution on sites. This kind of study was conducted through contacts with structural engineers, general contractors and specialist demolition contractors.

The understanding of design information is vital to be able to assess the feasibility of refurbishment activities on site and such information has to be translated into procedures that can be easily communicated to workers.

The study of the selected case study was developed through the observation of sites’ activities, project documentation, method statements, safety policies and health and safety plans. At the same time selected interviews were conducted with refurbishment professionals both from the client and the contractor’s team. The study of current management practices, the analysis of refurbishment projects’ documentation and site visits helped in the development of recommendations about health and safety management strategies.

The case studies provided good examples of good management strategies currently practised on sites showing that they can be extended to a larger number of
refurbishment projects. At the same time less efficient management strategies were identified for smaller sites for which specific recommendations should be developed.

3. Current management strategies in Refurbishment Projects

3.1 Impact of traditional procurement routes on health and safety management strategies on refurbishment projects

3.1.1 General contractor and specialist subcontractors

The traditional form of procuring refurbishment projects still appear to be the most popular route used in the construction industry: This route involves a principal (or “main”) contractor who is in charge of the appointment and management of specialist subcontractors. The relation between the Client, the designer, the contractor and subcontractors can be defined as “linear”.

The main contractor is, in most of the cases, a building company; specialist subcontractors can be demolition contractors, electricians, steel erectors, plumbers etc. In a refurbishment project involving demolition works the use of specialist demolition contractors is very important; their skill, the equipment they use, their experience and the trained workforce are key factors for an appropriate health and safety management of demolition activities. The traditional route gives generally little opportunity for early involvement of specialist contractors.

When such early involvement occurs, the selection of specialist demolition contractors for a specific site is normally carried out on a list of experienced contractors frequently used by the main contractors. Clients should seek to encourage the main contractors to provide information about frequently selected subcontractors in order to verify that the criteria used for the pre-qualification of the main contractor match those for the subcontractors.

The main contractors will have to co-ordinate construction activities with demolition operations. It is frequently suggested that demolition activities should be carried out separately from all other site operations, for a number of reasons. These include:

- Dangerous interferences between demolition activities and other works;
- Noise control;
- Dust control;
- Need to keep free an area close to a structure that may become structurally unstable during, or after, a demolition activity.

The traditional method of procurement can be suitable for refurbishment works but it has to be based on an accurate pre-qualification of demolition subcontractors. Another key factor is the communication of health and safety procedures to all subcontractors trying to co-ordinate all the safety procedures developed by each contractor for the specific site.
3.1.2 Management Contracting and Construction Management

The procurement route called “management contracting” is different from the traditional route because the principal contract is not for construction of the work but for its management. The Client appoints a contracting management company (see case study n.1 at paragraph 5.1) to manage the construction process. The “management contractor” will then organise project works into selected packages of construction works to be awarded to different specialist contractors.

Construction management scheme presents more fragmentation in the design and construction tasks; therefore requires a greater concern in co-ordinating the interface between project activities. This procurement method, due to the responsibilities concerned, needs a very good experience in control and supervision of all the parties involved.

As CIRIA RP626 reports “the involvement of the designer may be more limited, depending on the scope of duties defined in the appointments of both the designer and the construction manager; this needs to be considered in particular within the context of responsibility for the temporary works”.

3.1.3 Design and Build

Design and build procurement route, known also as “design and construction”, requires the contractor to be responsible for both design and construction of a given project. There are many variants of Design and Build procurement route. There could be variants of this route following an initial design concept developed for the Client and included in the tender. The original designers, appointed initially by the Client, can be novated to the contractor post-tender and remain involved throughout the project, or the contractor is going to appoint his own designers to develop the initial project.

This kind of procurement route may limit the Client in the project supervision as the contractor is going to take this role more directly. The Client will have to appoint a project supervisor, quite frequently appointed by experienced clients, to supervise the contractors’ work.

CIRIA RP626 reports “it is felt that there may be some conflicting pressures on design and build contracts between the requirements for full investigation and early preparatory activities and the need to adhere to tender and cost programme”.

3.1.4 Demolition and Temporary works as an advanced package

In this scheme the Client develops the demolition and temporary works procurement separately and the Principal contractor is often appointed after the appointment of demolition contractors. In this procurement route the Principal contractor becomes responsible for the Demolition contractors without having the possibility of performing pre-qualification or selection of the latter. So often, selection methods used by the Client are not as rigorous as those performed by the Principal contractor.
and Demolition contractors are often selected on the “cheapest price basis” without considering their qualification or experience.

Due to a lack of co-ordination with the activity of the Demolition contractor, Principal contractor will need to revise structural calculations and drawings as well as developing additional investigations on sites. In such cases the appointment of a Temporary Works Co-ordinator (see paragraph 3.7) is strongly suggested.

CIRIA project RP 626 has investigated in detail this procurement route and, even if developed for façade retention systems, recommendations can be easily extended to demolition activities. It is strongly recommended that all parties involved in the refurbishment project understand and agree:

- who retains responsibility for the design of temporary works;
- who is responsible for any checks and adjustments that are required;
- what financial agreements are in place;
- who is responsible for inspections;
- who is responsible for dismantling.”

This form of procurement is however not recommended for co-ordination problems that may occur between the appointed contractors and for the safety responsibilities involved that may not be so clear at the contract stage.

### 3.2 Key issues in health and safety management strategies for refurbishment projects

#### 3.2.1 Demolition design and planning

As already illustrated in WP1 report, demolition has to be considered as a whole independent building process characterised by a design, planning and execution phases. Design and planning of demolition activities have to be developed to avoid the generation of structural instabilities and the unplanned collapse of the structure. Clients and contractors have responsibilities in carrying out demolition design and planning activities. The client’s responsibilities are mainly related to the selection and appointment of the parties involved as well as providing all the resources (time and finance) to carry out adequate investigations.

The contractor is directly responsible for the development of demolition sequences and the temporary works’ design. An accurate health and safety management strategy will have to focus on the following issues while developing demolition design:

1. The Client has to appoint at the earliest stage competent engineers to develop structural calculations and to assess the feasibility of the demolition process;
2. The Client has to allow an adequate period of time during which engineers and architects are able to carry out surveys and researches on the conditions of the structure to be demolished. At the same time the structure has to be made available for inspections on identification of previous alterations or refurbishment works not recorded in the existing design documents.
To develop an accurate demolition planning phase:

- The Client has to select, also consulting the design team, the most suitable procurement route for the specific refurbishment work;
- The Client has to appoint at the earliest stage a competent contractor that will select specialist demolition contractors;
- Demolition engineers and Client’s structural engineers have to work together and share their knowledge and experience on the specific project. Demolition sequence, that can be assumed in the design phase by Client’s structural engineers, will have to be revised, updated or changed according to the specific procedures developed by the demolition contractor;
- Demolition contractor will have to prepare demolition method statements prior to undertaking any demolition activity; such method statements have to be revised and approved by the Project manager; it is strongly suggested that methods statements are also revised by the Health and safety manager and by the Planning supervisor.

The planning of demolition activities has to be co-ordinated with the working schedule of the whole construction works. It is commonly suggested to carry out demolition activities while all other site works are stopped to avoid dangerous interferences. The project manager has to develop a working schedule co-ordinating all contractors and subcontractors and trying to develop demolition activities separately from all other works.

For a great percentage of demolition and structural refurbishment works temporary structures, such as scaffolding, steel frames, façade retention systems are required. Prior to preparing any temporary works scheme the existing construction has to be understood in terms of conditions, load paths, loadings and relationship to possible adjacent buildings.

The contractor’s design team normally develops temporary structures’ design even if Client’s structural engineers may produce some recommendations or suggestion for the development of such design (see case study n.1 at paragraph 5.1). It is recommended that appointment be made of a Temporary Works Co-ordinator (see paragraph 3.7) who has the responsibility for the co-ordination of design, construction and dismantling of temporary structures.

### 3.2.2 Selection and use of plant and equipment

Prior to the start of any demolition work the demolition contractor should verify the most suitable type of machinery and equipment for the specific project. As reported in section 2 of the WP1 report, the analysis of equipment and tools is an essential part of the health and safety risk assessment. Mechanical equipment, such as electrical or pneumatic demolition hammers, have to be properly assessed due to the high level of vibrations that can be induced on adjacent structures. Every mechanical tool had to comply with the related health and safety regulation, it has to be type tested and carry the “CE” mark. Health and safety regulations related to hand-held mechanical tools for demolition work are mainly concerned with noise emission and vibration.
Depending on the materials composing the structure to be demolished the more suitable tool has to be identified and equipped with a suitable silencer.

When dealing with large demolition works, earthwork machines with hydraulic attachments are frequently used. Such machines have to be selected assessing the size of demolition work, structural condition and access facilities. Transport on site and space for storage are very important elements that affect machines’ selection. Buildings located in historical city centres might present difficult access as transportation, placement of big machines like excavators can be almost impossible. For demolition work where machines with hydraulic attachments are frequently used, smaller equipment has to be chosen even if such choice affect methods, cost and speed of the demolition works.

Exclusively trained operators should use hand tools or machine operated equipment; for the use of electrical or pneumatic hammers short shifts and frequent breaks have to be set up to protect workers’ health.

The health and safety manager has to check the list of equipment included in the health and safety plan developed by the Demolition contractor. Another important aspect that the contractor has to assess, prior to the start of work on site, is how to store and remove debris. Depending on the size of the site, places to store debris has to be located in order not to interfere with other activities. When debris has to be removed from higher floors an outlet system has to be put in place. When the outlets are placed outside the building it is common practice to secure them to external temporary works. In these cases the Temporary Work Co-ordinator will have to approve the position of such outlets.

3.2.3 Workforce pre-qualification, selection and supervision

One of the most important issues health and safety issue is to require specialist demolition contractors on site. Specialist contractors would use their experience to assess health and safety problems as well as developing accurate demolition sequences. Workforce employed by specialist contractors has to be properly trained and qualified to carry out demolition activities. It is known and sufficiently reported that the construction industry tends to employ many occasional workers with little skills and, quite often, poor knowledge of the local language. It is strongly suggested that workers have, at least, a basic knowledge of the language in order to be able to understand procedures and safety instructions that are communicated to them.

Construction workers are now required to undertake the Construction Skills Certification Scheme (CSCS). From this, they acquire the licence to be able to work on site. This basic training scheme has to be integrated with in-house training programmes. These training programmes will have to include health and safety talks showing drawing or picture-based information to overcome language barriers. Workers involved in demolition activities have also to be specifically trained on each aspect of the work they are to undertake. They need to be properly informed about the structure and share some engineering knowledge to be able to recognise any dissimilarity from design investigations and, if an unexpected finding occurs, they have also to be told to promptly report to their foreman or to the site manager.
Worker supervision is another fundamental issue within a health and safety management strategy. The first step to be undertaken for an accurate supervision of all workers on site is to require and obtain from all contractors and subcontractors a list of all operatives they are going to employ on that specific site. All workers will have to wear a badge indicating the company they are working for; different colour jackets or safety helmets are also recommended to identify different contractors operating on site. Contractors should ask subcontractors to provide a resident supervisor on site in order to enable site managers to supervise all gangs of operatives and give safety instructions. A demolition contractor’s supervisor has always to be on site during the execution of demolition activities; this would prevent the workforce from taking any initiative that may lead to the execution of unplanned and unauthorised activities.

3.2.4 Communication of project requirements and health and safety information

A key factor in completing a project safely is good communication of all relevant project and safety information. The communication of project requirements and of health and safety information has to be organised at different stages and at different levels.

The first level to communicate project requirements is within the Client’s team, between the designer (or structural engineer) and the Planning supervisor. In section 3 of the present report the role of Designer and of Planning supervisor is explained in detail; health and safety problems need to be identified, where possible, at design as a requirement of CDM regulations and Italian Safety legislation. Therefore the communication of design information and of any assumed execution sequence is vital for the Planning supervisor to identify execution’s risks that can be reduced at design stage. This will result in modification to parts of the design or in the implementation of specific safety procedures in the pre-construction health and safety plan.

The second level of communication is between the designer, or structural engineer, and the contractor. Project information has to be communicated in detail in order to share the engineering knowledge acquired during the design stage. Communication between designers and contractors during design changes is also fundamental. The exchange of information has to be mutual because the contractor, through his experience and skills, may add additional consideration to the project. If assumed demolition sequences have been developed they have to be explained to the contractor. The contractor may modify them adding the demolition method selected and the related plant and equipment.

The third level of communication is within the contractor and subcontractor’s team. Project information has to be communicated to the workforce and the site manager had to ensure they understand site rules and health and safety procedures related to the activities they are going to perform. Workers have also to be adequately instructed about not taking any initiative that has not been authorised by site managers.

Project information can be better communicated through drawing-based method statements. Instruction can be given to workers through regular brief meetings with workers; during these meetings a given group of activities can be tackled identifying
possible risks and the related safety measures or procedures. The instructions given to site workers have to be clear and concise and they have to capture the attention of the audience; therefore drawings and pictures are strongly suggested.

CIRIA project RP 626 provides quite a comprehensive list of communication issues that have to be maintained between all parties throughout the management of the refurbishment process. These issues can be easily extended from facade retention system to demolition activities. Communication issues listed in the CIRIA RP 626 report can be elaborated as follows:

- Arrange a briefing of site staff of all trade working on or around the demolition area both at the beginning of the project and thereafter;
- Provide details of all unexpected findings to the designers and the Temporary Works Co-ordinator during contractor’s investigation and demolition activities;
- Arrange regular meetings between the contractor’s site managers and the Client’s site representative;
- Establish formalised procedures for recording inspections, monitoring records, adaptations to the agreed demolition sequence and details of temporary works’ structure.

3.2.5 Health and safety education and training systems

Health and safety management strategies require all professional figures involved having a health and safety education. Health and safety education and training may vary depending on the duties and responsibilities of the figure involved. The Italian safety legislation requires a 120-hour training course to qualify as a Safety Co-ordinator. The UK construction industry often requires a NEBOSH certificate for Planning Supervisors, Safety Co-ordinators, and Health and Safety Managers.

Large construction companies require all their technical staff to undertake a minimum amount (based on their professional qualification) of health and safety modules every year. These safety training courses have to be appropriated to the staff’s duties and are very often organised by in-house training departments. Some companies (see case study no.1, paragraph 5.1) are expected to obtain a licence to practice as evidence of meeting minimum training requirements appropriate to their disciplines.

4. Key roles involved in the refurbishment process involving demolition activities

4.1 The Client

The Client is the promoter of the refurbishment project; he/she could be a single person or group of people as well as a company or firm. The Client can either be the owner of the property to be refurbished, or the Client can be simply in charge of the management and maintenance of the property. The primary role of the Client is to decide the nature of the refurbishment process based on the transformations to be
carried on the construction (i.e. structural alterations, change of use, restoration etc.); the Client will provide the financing for the execution of all refurbishment works.

In general contracting or in construction management scheme the contractor, or contractors, appointed will interface directly with the Client only occasionally. The Client selects an architect and/or an engineering company to develop all the design related to the refurbishment project. The engineers will instruct the contractors about the nature of the works to be carried out on site and they will supervise the works to control their conformity with design information.

It is essential that the Client allow an adequate time at the outset of the work to permit the design and procurement phase to be properly developed and to make the necessary allowance for proper investigation of the building where the demolition activities will be carried out. The Client has also to provide all the information he possesses about the existing site and make them available to the Planning supervisor (whose appointment is described below) and to the designers and structural engineers. The Client is responsible for the decision on the time frame of refurbishment works; the time frame is determined by the Client’s need to have the building ready due to the purpose of the refurbishment. In order to formulate suitable recommendations for refurbishment projects involving demolition activities Clients can be divided into two categories:

1. Experienced Clients or frequent procurers;

Experienced Clients are those who own or manage a relevant number of properties and have promoted different refurbishment projects or are likely to promote refurbishment projects quite regularly. Banks, Financial Institutions, Insurance Companies, Shopping centres firms, Cultural Institutes, State or Government Bodies are amongst experienced clients. First time Clients are normally identified with private individuals who want to undertake a refurbishment on a property for specific needs (i.e. house refurbishment). The differences between these two categories of Clients are not just based on the amount or value of the refurbishment works promoted. The experience and skills of Clients involved will provide a support for the management of the execution of all refurbishment works. Experienced Clients are characterised by:

- Lists of selected contractors or subcontractors that are called for tendering of refurbishment works;
- Pre-qualification methods to identify designers, engineers, consultants and contractors;
- Professionals specifically employed to supervise construction or refurbishment works carried out on the property assets.

Both in Italy and in the UK, Financial and Insurance companies have a building/property department that is in charge of monitoring the condition of all property assets. Such department develops refurbishment plans and contact professionals for refurbishment projects. Engineers who are employed by the company promoting refurbishment works can develop refurbishment projects but it is a common practice to appoint external consultants. It is frequently the case that
project managers, belonging to the above departments, are in charge of the refurbishment project’s control.

2. First-time Clients,

First-time clients are frequently unaware of all responsibilities involved in promoting a refurbishment work. First of all, the European Directive 92/57/EEC, interpreted in the UK with CDM regulations and in Italy with the Legislative Decree n. 494/96, requires the Client to be responsible for the health and safety management on the site of the building he/she has placed the order for. For the Italian legislation, the Client’s fundamental tasks consist of programming the construction work and in supervising the development of a Safety Co-ordination Plan at design stage and, subsequently, the application, during the execution phase, of what is envisaged by the said plan.

For the specific site the Client has to identify the standard duration of the individual activities and at the evaluation of the implications on safety of any overlapping, in space or time, of the said processes. The aim of this is to establish a reasonable contractual time; such as not to force the firm to neglect safety for carrying out work hastily. Any overlapping of operations must on the other hand be assessed to prevent any processes that are carried out at the same time from involving dangerous interference between them. To do so the Client is reasonably called to appoint a Safety professional identified in the Planning Supervisor for the UK legislation and the Design Phase Safety Co-ordinator for Italian regulations. First-time Clients should appoint qualified refurbishment consultants or an engineering company that will be able to develop a complete project and make suggestions for contractors’ pre-qualification and selection.

Clients should also limit the number of subcontractors while choosing the procurement route for the specific site. A limited number of subcontractors on site will allow an easier control and should contain the number of clashing activities or gangs of workers.

4.2 The designer

In the present context, the term "Designer" is used to refer to any of the professional figures involved in the design phase of the refurbishment work. Traditionally, the Designer is called upon to ensure the safety and health of the final users of the structure. The law does not ascribe to the Designer specific responsibilities in regard to the workers who must carry out the building or the maintenance operations in the course of the building’s service life. However, to avoid burdensome repercussions deriving from his relationship with the Planning-phase Co-ordinator or the Planning supervisor, it is desirable for the Designer to set himself the target of meeting a series of requirements regarding health, safety and quality of operations.

These requirements enable a prior evaluation to be made of the effectiveness of the design choices taken from the standpoint of the safety of the people carrying out construction and maintenance of the structure. In particular, as far as the phase of management and maintenance of the structure is concerned, it is of fundamental importance that the individual designers should draw up the Maintenance Plans of the
individual parts of the structure in order to facilitate the work of the Planning-phase Co-ordinator or Planning supervisor when he has to develop the Safety File.

The designer should ensure that the Client understands the need for an accurate survey and investigative work; the Client should therefore appoint professionals who will conduct and undertake such surveys, within a reasonable time before the actual works commences.

Before undertaking any design activity a designer has to take “reasonable steps to ensure that the Client for that project is aware of the duties to which the Client is subject by virtue of the CDM regulations”. The CDM regulation reports a list of tasks designers have to accomplish to guarantee safety on that project/site. The designer will have to develop the design activity including adequate considerations in order to:

- Avoid foreseeable risks to the health and safety of any person carrying out works on site or of any person who may be affected by site works;
- Combat at source risks to the health and safety of any person carrying out works on site or of any person who may be affected by site works;
- Give priority to measures that will protect any person at work or any person who may be affected by site works;

The designer will have to ensure that the design include adequate information about any aspect of the project, structure or materials that may affect the health and safety of any person carrying out works on site or of any person who may be affected by site works. The designer will also have to co-operate with the planning supervisor or any other designer who is preparing any other relevant design in connection with the same project or structure to enable them to comply with the requirements and prohibitions placed on him in relation to the project by or under the relevant statutory provisions.

4.3 The Structural Engineer

When dealing with refurbishment works involving structural alterations or demolition activities the role of the structural engineer is fundamental. He is directly involved in the structural and demolition design as mentioned in paragraph 3.2 of the WP1 Report. The structural engineer, or the team of structural engineers, will have to carry out a detailed and complete structural survey that requires the following information:

- Original structural design documents (drawings, structural calculations, etc.);
- Report of all structural alterations carried out on the construction in the past;
- Material samples taken form the construction to test real structural conditions;

A geotechnical survey may also be required if the structural alterations will increase or modify the loads on the ground. While developing structural surveys and the structural design, possible construction or demolition sequences can be assumed. While providing a simulation of a demolition sequence the structural engineer will be able to understand and study all the changes and modifications in the load path while the demolition proceeds. In fact the interruption of a load path, the effect of gravity

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12 The Asprey and Garrad’s building’s case study will provide an excellent example of this practice.
and the inability of the remaining structure to support any force redistribution may cause structural instability and therefore lead to an unplanned collapse. The study of such load changes will make it possible to develop appropriate procedures that will avoid a situation of structural instability for the structure to be demolished. All the information gathered during the survey and all the instructions that may derive from the project preparation have to be properly communicated to the contractors who will carry out demolition/refurbishment operations.

Preliminary meetings with specialist contractors should be organised prior to the beginning of demolition activities. These meetings are very useful to instruct site managers and operatives about what to do if they should come across situations on site that were not expected. Many accidents occur because workers keep on carrying out their activities in situations of structural instability generated by modifications not planned in the design phase. Structural engineers will have to inform contractors about and how to recognise all the “surprises” that they may face on site and how to deal with them.

Structural engineers may also be involved in the design of temporary structures developed to provide structural stability during the demolition phase. Temporary structures have a key structural role in partial demolition when it is necessary to provide a temporary support to that part of the construction not affected by demolition activities.

Specialist contractors are usually in charge of the design of temporary structures like structural frames or scaffolding. It is quite usual though that structural design engineers start to draw up a sort of “preliminary design” of temporary structures, while the specialist contractors mentioned above can subsequently develop this design. Structural engineers are also in charge of the supervision and control of demolition activities on site. They are required to update design documents if any differences from project information should show up on site.

### 4.4 The Planning Supervisor

The planning supervisor is a competent person who is appointed by the Client to fulfil a list of responsibilities in accordance with the UK or the Italian construction safety legislation. In the UK CDM 1994 regulations the Planning supervisor has a list of duties:

- Ensure that the design of any structure comprised in the project includes among the design considerations adequate regard to the need to avoid foreseeable risks to the health and safety of any person at work on site or of any person who may be affected by such work and to give priority to safety measures that protect those persons;
- Ensure co-operation between designers in order to verify they include health and safety considerations in design’s development;
- Give adequate advices to Client and contractors in order to make them comply with health and safety legislation;
• Develop the Health and Safety File.

In the Italian Legislative decree the Planning supervisor is distinct from the Planning Phase Co-ordinator; the Planning supervisor will act on behalf of the Client but not sharing legal responsibilities. The Italian Planning Supervisor’s duties are:

• Appointment of Safety co-ordinators;
• Supervision of the activity of the Design phase co-ordinator and of the Execution phase co-ordinator;
• Estimate of work activities and their duration’s;
• Preparation of the preliminary Site’s notice.

The Design-phase Co-ordinator prepares the Safety and Co-ordination Plan, which should identify, analyse and assess safety risks. It should also contain details of procedures and actions required ensuring that all legal norms relating to health and safety of workers are respected for the entire duration of the project. The Execution Phase Co-ordinator is required to perform his duties while the construction work and operations are being performed on site.

He or she must ensure, by means of appropriate control and co-ordination that the provisions contained in the Safety and Co-ordination Plan are implemented. The duties of the Execution Phase Co-ordinator also include updating the contents of the Safety and Co-ordination Plan dependent on how the works will be executed and if there have been any alterations to the proposed construction methods.

In the present context the term “Planning supervisor” will be used in accordance with the meaning used in the UK safety legislation while in the Italian construction industry the Design and Execution Phase Co-ordinators undertake the Planning supervisor’s duties. In a refurbishment project the Planning supervisor interacts with designers and structural engineers while the design phase is developed. The Planning supervisor will have to ensure that an adequate survey has been carried out prior to completing the structural design; at the same time he/she should be able to contribute during the preparation of demolition/construction assumed sequences.

The Planning supervisor develops the Client’s Health and Safety plan (also called “pre-construction” or “pre-tender” Safety Plan) that indicates health and safety requirements to be satisfied by contractors while working on site (see fig. n.1 ). The principal contractor (or the construction manager company) has to develop a Health and Safety plan for the specific site. The Italian Legislative decree introduced the Safety operating plan that is equivalent to the Contractor’s Health and Safety plan; it must include:

The Planning supervisor has to make sure that the safety measures on site are in accordance to the requirements of the Client’s health and safety plan and to the procedures of the Contractor’s heath and safety plan.

• Risk assessment and methods used for risk assessment;
- Identification of safety measures and of personal protection equipment arising from the risk assessment;
- Work activities’ schedule to ensure safety on site.

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**Fig 1 – Interaction between the Planning Supervisor and other Professionals involved in the design phase of a refurbishment Project**

### 4.5 The Principal contractor

CIRIA Report 172 provides a list of duties for the Principal contractors as reported below:

- Prepare, develop and implement the Health and Safety Plan;
- Co-operate with the Planning supervisor;
- Co-ordinate and direct the handling of health and safety issues by all the contractors on site, including the enforcement of any written site rules;
- Appoint only competent and adequately resourced contractors;
- Provide the Planning supervisor with access to their own designers and the designers of other contractors;
- Limit access to the site only to authorised persons;
- Ensure that contractors’ employees are informed, trained and consulted about health and safety;
• Display the HSE notification on site and ensure that people on site are aware of the site rules;
• Supply and co-operate in the collection of information for the health and safety file.

In a refurbishment project the principal contractor is required to select competent specialist demolition and/or temporary works contractors. He is also required to appoint a competent structural engineer, if not already employed in the company, to develop structural calculations to verify load paths and overloading while carrying out demolition activities and to design temporary works when necessary.

The principal contractor is suggested to appoint a temporary works co-ordinator who will supervise the design, the construction on site and the dismantling of temporary works (the role of the temporary works co-ordinator is described in detail in paragraph 3.7).

4.6 The demolition contractor

The demolition contractor is required to be a competent contractor (or sub-contractor) who is in charge of the execution of demolition works. The demolition contractor has to provide selected and qualified workforce and equipment. Demolition tools have to be selected after assessing the quality of the construction to be demolished and the surrounding environment.

The principal contractor, or the Construction Manager Company, will provide the demolition contractor all the information available from the Client organisation including structural design documents and results from site surveys and inspections.

The demolition contractor is strongly suggested to carry out further investigations on the construction, pointing out elements that may have been omitted or left aside; any unexpected finding needs to be reported to the Client and to the design team to allow relevant modifications to be brought to the project before works start. The demolition contractor has to produce a specific risk assessment for the demolition activities and develop method statements to be handed to the principal contractor.

The principal contractor will revise them, in co-operation with the Planning Supervisor, and include them in the Health and Safety Plan (see fig.no.2). The approved method statements have to be communicated to the workers including health and safety instructions and procedures.

Co-operating with the principal contractor the demolition contractor may find it useful to organise brief toolbox talks on health and safety topics especially for workers with little experience.
Organise brief toolbox talks on health and safety topics especially for workers with little experience. The demolition contractor proposes a specific demolition method and sequence that may or may not comply with what assumed at the design stage. Any substantial change in the assumed demolition process has to be discussed with the Client’s design team and with the principal contractor prior to undertaking any initiative.

### 4.7 The Temporary works co-ordinator

Under CDM regulations the Client is required to employ a competent person to supervise and control the work on site. For refurbishment works involving demolition activities and subsequent temporary works a suitable appointment could be the Temporary Works Co-ordinator.

In CIRIA project report RP626 the Temporary Works Co-ordinator is defined as “to be responsible for the co-ordination of temporary works and for ensuring that all components of the design and detailing will fit together and result in a safe and stable structure at all times until the permanent work entirely replaces the temporary work in all respects”.

In refurbishment works involving demolition activities the Temporary Works Co-ordinator should supervise the design activity developed by structural engineers appointed by the Principal contractor or by the demolition contractor. He/she will
have to supervise the construction of temporary works on site and control constantly any modification or instability that may occur during demolition phases (see fig. no.3). If unexpected findings should occur such to modify the knowledge of the structure to be demolished, the Temporary Works Co-ordinator will have to supervise the changes to the temporary works design and assess their compliance with the new structural behaviour of the structure itself.

Fig.3 – Role and duties of the Temporary Works Co-ordinator

It is suggested that the Principal Contractor appoints the Temporary Work Co-ordinator and case study n.1 in paragraph 5.1 will provide a good example of his actions. In the Italian scenario the Temporary Works Co-ordinator has not been introduced yet. However parts of his duties can be recognised in the work of the execution phase co-ordinator.

The Client appoints the execution phase co-ordinator and his task is ensuring, through appropriate action of co-ordination, the enforcement of the provisions contained in the safety plans and corresponding working procedures. In the event of any variations being introduced in the construction process that may be significant in terms of worker safety, the Execution-phase Co-ordinator must also see to the necessary updating of the Safety Plans and of the Health and Safety File.
5. Case studies: criteria for selection and elements of interest

To investigate health and safety management strategies in refurbishment projects and the related key issues some case studies were selected and analysed. The refurbishment sites selected had to match the following criteria:

- Refurbishment works had to include demolition activities and, possibly, the use of temporary structures;
- Refurbishment sites had to be located in the city centre to allow the investigation of health and safety and logistic issues related to the age of the construction, adjacent buildings, placement of temporary works and the supply of mechanical equipments;
- The contacts developed to get information about refurbishment projects and to be able to carry out site visits had to be either from the Contractor or the Client’s team; this requirements was very important to investigate refurbishment projects from different perspective (Client or contractors) of the refurbishment process itself;
- All refurbishment sites had to comply with CDM or Italian safety legislation;
- Refurbishment sites had to be of different sizes to allow the possibility to explore a wider range of examples representing the real situation of the UK and Italian construction industry;
- Selected sites had to present different procurement routes, especially general contracting and construction management, involving specialist demolition contractors.

After developing the criteria above five refurbishment sites were selected, three in the UK and two in Italy, all matching the requirements set above. At the present moment demolition activities have not been completed on all sites. Any additional key finding not already included in the present report will be detailed in the final and conclusive report of the research programme. Prior to undertaking site visits initial contacts were arranged with professional figures responsible for those sites. Meetings followed the preliminary contacts and for that context a list of questions was developed; such list was tailored to the role of the person to be interviewed. The selected number of professionals contacted during this phase of the research programme did not allow the answers to the questions to be analysed statistically. However the list has been prepared and it is in the process of being circulated between a larger number of structural engineering consultancies, general contractors and demolition contractors to generate a more global and complete overview of health and safety issues in the refurbishment sector.

The answers received from the prepared list were useful in organising the structure of sites’ investigation and in identifying those issues and professional figures who need to be analysed in more detail to acquire quicker and richer information from sites’ visits.

Project description
The building selected for the first case study is located in a residential and commercial area between Sloan Square and Belgrave Square in the centre of London. The refurbishment site involves the change of use of a four-storey commercial building into a food hall with offices. The building is characterised by two atriums that cut the construction crosswise for its whole height (this is why it is called Halkin Arcade). The structure of the underground and ground floor had to be completely removed to allow the realisation of two open spaces. The open space at the underground floor will be used for storage while the ground floor will be entirely occupied by a supermarket. The removal of the lower part of the structure required the preparation of temporary works to retain the upper part of the construction during all demolition activities.

The temporary works structures have been preliminary designed by the client’s structural engineer and subsequently developed by the contractor’s temporary structures engineers. The temporary works consist of two structural frames located at the basement of the construction. The length of these frames is equal to the cross section of the building and their height is equal to the heights of the underground and ground floor together. At the top of these frames there are several needle beams that are inserted into the vertical walls to support the upper vertical structures. Many parts of the frames are fabricated off-site. Other steel works were welded into position to suit the actual conditions on site.

A suspension system has been used to sustain the horizontal structure that is composed of three floors on the external sides of the two atriums. The use of internal temporary works avoided the erection of façade retention structures on the roads, in the front and at the back of the building.

The presence of two masonry chimneys has been of great concern for the contractor structural engineers. The chimneys were offering a partial support to the roof structure even if they cannot be considered as structural elements. These chimneys are also based on two hollow ovens located in the underground floor (one of the chimneys was also located in an eccentric position to the centre of its foundation). The contractor decided to prop the ovens and to consolidate the chimneys prior to the start of any demolition work in order to prevent any structural alteration in the chimneys and in the roof structure. Part of the structure of the internal floors cannot be demolished due to restriction imposed by the English Heritage. These floors will be supported by the suspension system mentioned before.

Management scheme
Bovis Lend and Lease manages the project through a construction management scheme. They have selected specialist contractors for construction and demolition works. They will select other specialist contractors while the refurbishment site progresses.

Bovis has a temporary works department that is in charge of the supervision of the design and execution of all temporary structures. Temporary structures’ co-ordinator, or supervisor, is appointed on each site. This role is akin to that of the site manager.
The site manager and all the representatives of the specialist contractors on and off site have to report to the Bovis project manager prior to undertaking any activity. The project manager checks all the sequences of the demolition activities before issuing the approval to undertake parts of demolition works.

**Project duration**
The erection of the temporary frames started at the end of April and the demolition works in the basement have been carried out from the end of May 2002 until the end of June 2002. All demolition activities should be completed by the end of the summer, while the refurbishment project has to be completed by autumn 2003.

**Elements of interest**
This case study has been selected for the following reasons:

1. Site location: down town London in a commercial area with narrow and busy road bounding the buildings under refurbishment.
2. Peculiarity of the structural problems: presence of structures, e.g. chimneys that require accurate investigations and precautionary measures to avoid unplanned collapses.
3. Peculiarity of the temporary works to be used during the structural refurbishment: vertical temporary works specifically designed for this site and suspension systems to hold the horizontal structures in order to disengage the floors from the structural walls that have to be demolished.
4. Management strategy that includes professional figures specifically tailored for refurbishment sites such as the temporary works' co-ordinator.
5. Experienced contractor for refurbishment sites: a large proportion of Bovis Lend and Lease working output involves refurbishment project.

**Demolition design and planning**
Bovis structural engineering department, in co-operation with Client’s structural engineer and Demolition contractor’s engineers, developed the demolition design phase. The client’s structural engineers proposed a demolition sequence and a temporary works scheme design that could guarantee structural stability during demolition works. It was clear since the design stage that the complete removal of structural elements in the ground and underground would have seriously compromised the global stability of the construction. At the same time two fundamental requirements need to be satisfied during demolition works:

1. Provide a sufficient space inside the building to perform demolition activities;
2. Do not use façade retention systems on Motcomb Street due to the narrow width of the street itself.

For these reasons a quite complex system of steel temporary frames was put in place. This system provides a very strong support for the whole building allowing demolition workers to carry out their activities without the risk of a partial collapse of the structure.
All the structural parts of the building, that had to be maintained, were controlled using electronic and visual instruments to verify any movement during demolition activities. The temporary frames will be removed only when the permanent steel frames will be erected to provide the final structural support to the building.

**Selection and use of plant and equipment**
The amount of demolition works was quite considerable but due to space constraints in the ground and underground floors Bovis engineers excluded the use of large-size excavators. Demolition contractor included in the method statements a list of machines and plants that were suggested to be used and the Project manager approved this list. These included pneumatic hammers on the ground floor. On the underground floor small-size excavators were used to remove masonry structural elements such as vaults and buttresses.

**Workforce pre-qualification, selection and supervision**
Bovis organises site’s audits prior to accepting any workers (contractors or subcontractors) on site. These audits have to be periodically repeated and all site personnel have to attend them. Workers who have not been initially instructed with such audits are not admitted on site. Workers have also to show on their personal safety helmet the date of the last audit they attended.

Demolition contractor reported in demolition method statements control measures for the supervision of the workforce; these control measures are described below:

- All works had to be supervised by a competent person(s) who has experience with the type of operations listed in the description of works to be performed;
- Prior to commencement of the works all operatives, charge-hands and foreman will have the method statement explained to them in detail; all personnel will sign a register to confirm that the method statement has been read or explained and that it has been understood.

As a standard safety policy the company requires a great involvement and commitment by each contractor in the supervision of the workforce; such requirements are formalised in the HSE manual developed by the company and can be summarised as follows:

- Each contractor has to allow their operatives participating in the site induction and at intervals hereafter should the nature of the site significantly change.
- The contractor has to prepare a programme of toolbox talks and to deliver them to all persons under their control.
- All first line supervisors will carry out daily briefings of their operatives prior to the start of work on the tasks to be undertaken, location, equipment, materials, PPE and safety considerations.
- Unless otherwise agreed each contractor will arrange for a professional safety adviser to conduct a safety inspection at weekly intervals as a minimum, with a copy of the report submitted immediately following the inspection.
- The construction manager will carry out a weekly inspection for which all contractors are to make their most senior person on site available.
• The contractor will maintain a representative on site who is available to receive and implement safety instructions at all times when work is being undertaken by the contractor.

**Communication of project requirements and health & safety information**

Project information was very much detailed. The sequences of the erection of temporary frames and of demolition activities were properly illustrated in a series of structural drawings. Prior to the start of refurbishment works many meetings have been organised between construction managers, client’s structural engineers and demolition contractors to analyse all the possible structural problems that might have occurred during demolition activities and the erection of the permanent steel structure. The safety policy of the construction Management Company requires that before the Contractor commences on site a pre-start meeting must be held at which the Contractors’ Project Manager and Site Manager should attend. This meeting is used to ensure that all information is available to the contractor and that he is fully aware of the site rules and that all his initial safety precautions i.e. risk assessments and method statements etc. are in place.

As mentioned earlier, before any operative commences on site, they must receive an induction talk which provides the attendees with specific information i.e. site rules, emergency procedures, fire precautions, training required, first aid and welfare facilities, use of PPE, site specific hazards, permit systems, etc. Again, as reported earlier, health and safety audits are periodically organised to introduce workers to site. Safety leaflets and posters are distributed to workers after every audit trying to make them even more sensitive to health and safety issues.

**Health and safety education and training systems;**

In the previous section information about health and safety training on site (pre-start meetings, toolbox talks etc) has already been provided. That kind of health and safety was related to contractors and subcontractors’ workforce but a health & safety training system is organised for Bovis managers as well. Bovis engineer and managers have to undertake, every year, an Environmental; Health and Safety training programme appropriate to their duties. Some staff is required to achieve a Licence to Practice as evidence of meeting minimum training requirements appropriate to their discipline.

For the selection of competent and trained workforce Bovis support a number of registration schemes and it is required those appropriate trades skills certificates, or an approved alternative, are provided on request. These certificates shall confirm that the employee is - fully trained, competent and authorised.

The recognised competence based registration schemes are:

1. Construction Skills Certification Scheme (CSCS)  

   - Bench joiners  
   - Bricklayers  
   - Built up felt roofers  
   - Carpenters and joiners  
   - Ceiling fixers

   - Cornish masons  
   - Dry liners  
   - Facade cleaners  
   - Form workers  
   - Mastic asphalters

   - Plant mechanics  
   - Plasterers  
   - Roof slaters and tilers  
   - Sheeters and cladders
Research Project “Health & Safety in Refurbishment Involving demolition and Structural Instability”

Construction operative: Painters and decorators Shopfitters
- general - decorative - site fixers
- concreting - industrial - bench joiners
- drainage Partition fixers Single ply roofers
- paving Piling operatives Stonemasons
- street working Wood machinists

Note: Unskilled labourers are not covered by the CSCS scheme and so are not included in these certification requirements.

2 Certificate of Training Achievement (CTA) - Construction plant operators
3 BICS Operators Proficiency Certification Scheme (Cleaning)
4 Registration and Certification Scheme for Window and Curtain Wall Installation (Bath University).
5 UK Register of Electricians
6 British Locksmiths Association
7 Leadworkers Certificate
8 Engineering Construction Skills Database
9 EITB/EMTA (Engineering and Marine Training Authority) NVQ3 in lift maintenance/ installation engineering (or apprenticeship)
10 UK Register of HVCA Operatives
11 UK Accreditation Service for Gas Installers (BCOP, - CORGI Replacement)
12 Building Engineering Services Scheme (CITB)
13 Gas Distribution Record Scheme
14 JIB Plumbing Registration Scheme
15 JIB Gas Grading Scheme
16 JIB Electricians Scheme
17 Scaffolding Registration Scheme
18 Steeplejack & Lightning Conductor Fitters Record Scheme
19 Tunnel Miners Record Scheme
20 Scheme for the Certification of Competence of Demolition Operatives (Topman and Mattockman)
21 Concrete Repair Operatives Record Scheme
22 Spray Concrete Registration Scheme
23 Drilling & Sawing Operatives Registration Scheme
24 Street Works Excavation & Reinstatement
25 Construction Skills Register (N. Ireland)
26 Scottish Construction Operatives Registration Executive (SCORE)
28 The Fencing Industry Skills Scheme (FISS)

Bovis has a general safety procedures manual in which all safety issues are analysed including also health and safety rules on site and company’s policy. A section of the safety procedures manual is dedicated to demolition activities whose contents are listed below:

- Hazards of the Work
- Bovis Lend Lease Policy
- Bovis Lend Lease Policy On Taking Over An Existing Demolition Contract
- Statutory Notifications
- Safety Legislation
7. Sloane Square Church, London

Project description
The refurbishment work selected as a second case study is the refurbishment and change of use a church situated in Sloane Square, Knightsbridge, London. The project includes extensive demolition activities to change the church layout into an auditorium and two months of asbestos removal activities have already been completed.

At present demolition activities have been stopped due to a legal action undertaken by the owner of the building adjacent to the church. However the Safety documentation provided by the contractor was very detailed and provided a good example of health and safety management strategy to be presented in this report. The project presented a
general contracting procurement route and Walter Lilly is the principal contractor appointed for this job.

**Demolition design and planning**
Walter Lilly has an internal temporary works department that developed temporary works design. Due to the internal height of the main atrium of the church, scaffolding towers were required for asbestos removal and for the planned demolition activities. The Demolition contractor, selected from a list of qualified company, developed a demolition sequence that is going to be revised when the principal contractor will get the authorisation for the restart of refurbishment works. The Demolition contractor also developed method statements for the demolition activities to be performed including site-specific risk assessment and the related safety measures.

**Selection and use of plant and equipment**
The demolition contractor prepared a list of plants and tools to be used for demolition activities. Due to lack of internal space and the height of structural elements to be removed the demolition contractor indicated the use of mechanical hand demolition tools as pneumatic and electrical hammer.

**Workforce pre-qualification, selection and supervision**
Walter Lilly employs a safety officer to interview and select subcontractors (even if they have a selected hardcore of subcontractors) and formalise what their duties are on site and if they have understood and going to accept site rules. Walter Lilly requires all subcontractors to provide a list of workers with their qualification and training schemes attended. In the Health and Safety plan a database of all the workers employed on site is included. Information such as National Insurance Number and home contact details should be included in this list. This helps identifying irregular workers who cannot be accepted on site. However this additional safety information sheet is not enough to test workers safety knowledge and behaviour, but when some information is missing the level of supervision should be higher.

Walter Lilly appoints for every single site a resident health and safety manager and an internal health and safety inspector is required to carry out site inspections on a monthly basis. The firm also requires subcontractors to provide a resident supervisor who is able to receive safety information and to instruct operatives about safety procedures and construction instructions.

**Communication of project requirements and health & safety information**
Before any subcontractor starts site works an induction has to be attended by managers, foremen and workers. This induction covers both project and safety information. The safety induction has to be repeated every month if the subcontractor is still working on that specific site. The induction is presented on A3 sheets with many pictures often showing injuries caused by accidents on site trying to shock workers and making them feel more safety responsible while performing their duties. Main topics of the health and safety induction are listed below:

- Entry to site
- Method statements
- Walter Lilly site rules
• Personal Protection Equipment
• Secure excavations
• Emergency procedures
• Fire protection
• Fire extinguishers and their use
• Welfare facilities
• First aid facilities
• Safety signs and their meanings
• Hazardous substances
• Electrical equipment
• Manual handling
• Hand arm vibration syndrome
• House keeping

Walter Lilly has a health and safety plan that refers to the Safety procedure manual and includes method statements developed by the firm and those provided by subcontractors as well as safety management forms. The Health and Safety plan is written in a very simple and understandable way to ease the communication to the workers on site. The Health and Safety plan has to be simple so that in any moment it can be passed to another site manager if the previous one cannot manage that site anymore. In the Health and Safety plan there are also sheets regarding “site safety information” which summarise the main safety procedures for a particular group of activities on a given day. Due to language problems these safety information sheets should be integrated with illustrations and drawings. The main contents of the Health and Safety information sheets are listed below:

1. General
2. Work conditions
3. Personal rules
4. Welfare facilities
5. First aid
6. Special hazards
7. Emergency

*Health and safety education and training systems;*

The main contractor appeared to be very focused on implementing a safety-oriented management strategy that can be obtained only with adequately trained managers and supervisors. The contractor’s personnel are subjected to very frequent health and safety audits as well as health and safety managers who have to attend safety training programmes every two years.

8. Asprey and Garrad’s building, New Bond Street, London

*Project description*

The site will involve the structural refurbishment and the upgrade of the internal layout of the buildings originally occupied by the Asprey and Garrad’s jewellery shop. The refurbishment works will be carried out on the entire property, which
includes six buildings situated between Albemarle Street, Grafton street and New Bond street. The most interesting area of refurbishment activities includes the portion of the property facing New Bond Street. In this part of the building, important demolition activities will be undertaken. This part of the building has been affected by substantial structural alterations carried out in the 20th century and detailed in the investigation report developed by Alan Baxter’s structural engineers.

The most concerning structural alteration has affected the first two floors of the building on New Bond Street. To create an open space for the jewellery all the beams and the biggest columns were removed leaving only few slim pillars. The structural behaviour of this part of the property and the possible changes during demolition has been carefully investigated before the start of any refurbishment work.

The building, due to its age and location, is listed and the English Heritage has required that the facade have to be maintained in place with the existing features, therefore structural façade retention will be necessary during the structural refurbishment. In the core of the six buildings, the architect has designed a courtyard covered by a glass roof. The construction of this courtyard will involve a substantial demolition of the internal core demanding internal façade retention for some parts of the structure.

Management scheme
Initially the procurement scheme was a construction management scheme. The refurbishment works were divided into different packages of construction works to be awarded to different specialist contractors. Alan Baxter engineers have almost completed the final part of the design phase; structural and demolition packages are ready for the execution phase. During the design phase the Client modified the procurement route and the construction management scheme was then changed into a general contractor. The general contracting company has already been appointed.

Project duration
The buildings and the shop have been evacuated in the middle of May 2002. Planning permission and the English Heritage approval are due at the beginning of June 2002. The main contractor has already installed site facilities in the property. Demolition works should start for the beginning of August 2002. The refurbishment has to be completed for the reopening of the jewellery store in December 2003.

Elements of interest
This case study has been selected for the following reasons:

1. Site location: down town London in a commercial area with narrow and busy road bounding the buildings under refurbishment.
2. Peculiarity of the structural problems caused by previous alterations to be taken into consideration in the design phase of the project.
3. Peculiarity of the temporary works to be used during the structural refurbishment: internal and external façade retention and strengthening of the horizontal structures due to the lack of vertical support caused by the past removal of all the principal columns.
4. Interesting way of developing demolition method statements assumed by the structural engineers: such method statements are provided with drawings that illustrate how works should be carried on. All the information included in these statements is based on the preliminary research developed on the original construction and all the subsequent alterations.

5. Experienced engineering consultancy: a large proportion of Alan Baxter’s working output involves refurbishment project and at the moment they are developing an interest in historic buildings and conservation issues. They have consolidated procedures to tackle refurbishment projects based on the most possible accurate preliminary researches to investigate original design and construction as well as all the alterations that can be observed and understood before the site commences.

Demolition design and planning
The design and planning of demolition activities has not been completed yet. However structural engineers have developed an assumed sequence of demolition that is going to be discussed with the appointed demolition contractor. The complete process of demolition design and planning will be illustrated in the final report of the research programme.

Selection and use of plant and equipment
The selection of demolition plant and equipment has not been completed yet but due to the limited internal space and access to the building the structural engineers have strongly suggested hand demolition methods.

Workforce pre-qualification, selection and supervision
The contact for this case study was developed through the Client’s structural engineers. The consultancy helped the Client in selecting the principal contractor providing references of past projects developed together. The main contractor and the demolition subcontractor have a great experience in refurbishment projects involving demolition activities and façade retention. Additional information about workforce qualification will be added once demolition activities will start and will be reported in the final report of the research programme.

Communication of project requirements and health & safety information
The structural engineering company is very focused on communication issues and they developed their drawings and design documents in order to be easily understandable and executable by the contractors. The investigation phase has required a lot of efforts from structural engineers and architects and a detailed report on the findings was developed and explained in detail to the contractor. The engineering company is also used to set up seminars prior to the start of the site to fill up the contractor with engineering knowledge and to understand together what to do in case of unexpected findings.

As a design procedure structural engineers develop method statements called “sequence of construction assumed at design stage”. This sequence is developed while carrying out the design phase and it is meant to identify possible construction methods for contractors. The sequence is illustrated in a group of drawings that assume a sequence of work which can be seen as logical, feasible and safe; it will provide a
construction site’s tool in order to “manage surprises” which are quite common in a refurbishment project. Such construction method is not necessarily the one that the contractor will implement. In this case the contractor will modify and develop a new sequence of construction.

Health and safety education and training systems;
The structural engineering company puts a lot of attention and efforts in the internal training of their employees. Specialist engineers have developed a collection of technical notes that are periodically updated. These technical notes are meant to circulate throughout the technical staff to provide a general knowledge of engineering and safety subjects. They also have a small area in their offices where material and construction samples are collected to show their use and functions to young and inexperienced engineers.

9. Residential building, via Gorani, Milano

Project description
The building chosen as the first Italian case study for the research is located in the heart of the Milan historical centre close to the financial district and to the Stock Exchange building. The construction is four stories high and the interior of the building needs to be completely demolished keeping the façade intact due to Historical Heritage requirements. After demolition works the building will be entirely reconstructed and used as a private dwelling. It was not possible to find any project description or design documentation about this house. No information about past refurbishment works has been available.

This area was seriously damaged by the 1943-1945 German bomb attacks; therefore it is possible that this house have been damaged as well. It is clear that the overall structure is seriously compromised. To avoid structural collapses during demolition activities all the structure has been secured with a support system composed of shores and props. Some parts of the internal pavements have already collapsed requiring protection devices around the openings left in the floors and a structural engineer appointed by the contractor has developed a structural survey.

Due to a two-storey elevation added at the beginning of the last century the lower masonry structure has been considerably overloaded because the structure of the top floors is made of concrete floors and columns. This situation has required a particular attention in developing the demolition sequence and the activities on the top floors have been carried out exclusively by hand demolition. The building is situated between two other buildings with common division walls. These adjacent buildings have been propped and supported with structural scaffolds to retain the division walls once disengaged from the horizontal structures after their demolition.

Management scheme
The client (who is the owner of the property) appointed a principal building contractor with a private procurement route. The main contractor has selected specialist subcontractors for some groups of activities. For demolition works, the main contractor has appointed a specialist demolition contractor that is frequently appointed
for this kind of project. This project is under the “Italian CDM” regulation (d. Lgs. 494/96); therefore the following personnel are involved on site:

1. Site manager: appointed by the main contractor. The site manager is always on site.
2. Technical manager: representative of the main contractor who gives the instructions to the site manager. The technical manager is not always on site because he is in charge of the supervision of different sites.
3. Execution phase safety co-ordinator: appointed by the client. He is charged with the control of the observance of the procedures included in the client’s Health and Safety plan and of the completeness of the contractor’s Health and Safety Plan (the so-called Operating Safety Plan).

**Project duration**
Demolition activities started at the beginning of May and finished at the middle of July. The construction of the new building should be finished by the end of 2003.

**Elements of interest**
This case study has been selected for the following aspects:

1. Site location: central Milan in the old medieval area with narrow and busy roads around.
2. Peculiarity of the structural problems: presence of structures seriously compromised by previous collapses that require accurate studies and precautionary measures to avoid premature collapses during demolition activities.
3. Peculiarity of the site’s organisation: the site is adjacent to another refurbishment site, therefore internal viability and site facilities have to be organised in order not to create dangerous interference.
4. Management system that includes professional figures specifically tailored for Italian refurbishment sites.
5. Experienced contractor for refurbishment sites: a large proportion of Minotti Costruzioni working output involves refurbishment project.

**Demolition design and planning**
The client’s structural engineer mainly developed demolition design after a two months’ survey on the existing structure, while the contractor supervised the demolition design activity and required the consultancy of an external structural engineer. Due to the worrying structural conditions of the building it was agreed to demolish one floor at a time and then having a co-ordination meeting to assess the stability of the building and the suitability of demolition method for the remaining part. The lack of structural information required engineers and contractor to proceed very slowly with demolition works in order to be able to face any unexpected findings or instability emergencies.
The previous experience of the adjacent site showed that the internal courtyard could bring out archaeological finds. Demolition sequence included also intervals where it was possible to temporarily stop activities to carry out archaeological surveys.

**Selection and use of plant and equipment**
The selection of plant and equipment was strongly influenced by the restricted access to the property and by the poor structural condition of the building. For the top concrete structure electrical demolition hammers were used. For the whole structure above hand demolition tools were exclusively used. The consistency of the ground in the courtyard and the narrow gate at the entrance of the property didn’t allow the use of any excavators or demolition machine.

**Workforce pre-qualification, selection and supervision**
The main contractor used a specialist demolition subcontractor that is always employed for demolition works. Skilled workers provided to be properly trained and selected even if they didn’t attended any construction-training scheme. Most of the labourers were foreigners and some language problems rose during works’ execution.

The execution phase co-ordinator provided a sufficient supervision of demolition activities especially in the most difficult sections. Due to the restricted size of the site and the number of workers involved, the supervision of the site manager provided to be sufficient for most of the demolition works.

**Communication of project requirements and health & safety information**
Demolition sequence and temporary works design was sufficiently detailed in executive drawings. The pre-construction health and safety plan illustrated safety procedures during the development of demolition activities even if no drawing-based sequence were included. Prior to the start of refurbishment works the site manager and the health and safety co-ordinator organised a co-ordination meeting to communicate safety issues to the foreman and skilled operatives.

**Health and safety education and training systems;**
The contractor health and safety policy involves a safety-training programme for all his engineers and technician. Health and Safety managers are required to attend the 120 hours Safety co-ordination course as required being a qualified Safety Co-ordinator.

Young workers are now required to attend professional building courses to be able to work on site. These professional courses cover very practical topics and include lectures on health and safety procedures on site.

10. Residential building, via Donizetti, Milano

**Project description**
The building chosen as the second Italian case study was under major refurbishment works promoted by a new owner who decided to turn such a building into his new home. This house is located in central Milan on a narrow one-way road. Being a listed
building the refurbishment project only included internal structural alterations and layout changes without any works carried out on the facades for the exception of cleaning and conservation activities. The building was originally divided into four flats, the new owner decided to start the refurbishment works to turn the building into a single five-storey house serviced by a small elevator.

The conditions of the old structure suggested the removal of all internal vertical and horizontal elements composed of wooden floors and masonry walls. The project included the construction of a new steel structure composed of steel columns and beams with concrete floors on corrugated irons. A structural survey was conducted on the construction prior to completing the design phase to understand the structural behaviour of the building that had a two-storey elevation in the 1950s.

**Management scheme**
The client and the designer (who was also the Works Manager and the Planning Supervisor) selected the main contractor through a private procurement route. The contractor could rely on the demolition specialist workforce for the demolition phases and the erection of the steel structure. Specialist subcontractors were used for plants and finishing.

**Project duration**
The refurbishment started in April 2001 and will be completed in the beginning of July 2002. The demolition works were carried out from May 2001 through to October 2001.

**Elements of interest**
This case study has been selected for the following aspects:

1. Site location: central Milan on a narrow and busy one-way road.
2. Peculiarity of the structural problems: presence of structures weakened by previous elevations that require accurate studies and precautionary measures to avoid premature collapses during demolition activities.
3. Peculiarity of the temporary works to be used during demolition activities and structural re-construction: locally reinforced elements and demolition sequence developed to avoid façade retention systems.
4. Management system that includes professional figures specifically tailored for Italian refurbishment sites.

**Demolition design and planning**
The survey developed by the structural engineer revealed the need for reinforcement in the foundations and on the vertical structure in order to support the new load paths deriving from the steel and concrete structure. The foundations were underpinned in different sections prior to beginning any demolition activity. The Structural engineer and the Planning Supervisor carefully planned the demolition sequence in order not to leave the structural external walls unbound after the removal of the internal structural elements.
To maintain the structural stability of the construction while performing demolition activities, it was decided to remove the internal structure floor by floor. The second and fourth floors were removed and the new steel structures were placed into position before proceeding to the demolition of the other floors. With this sequence the external walls were all bound together with a global structural stability for the all construction without using any façade retention system.

**Selection and use of plant and equipment**
Due to the restricted access to the building no demolition machine could be used. Mechanical hand demolition tools were used for the demolition of selected parts of the structure.

**Workforce pre-qualification, selection and supervision**
The execution phase co-ordinator required that the entire workforce on site should be trained and qualified for their duties. Regular site inspections were carried out by the structural engineer and by the execution phase co-ordinator.

**Communication of project requirements and health & safety information**
The structural engineer, the designer, the contractor and the execution phase co-ordinator held a weekly meeting on site to show to the site managers and to foreman project changes and to explain construction phases and safety instructions.

**Health and safety education and training systems**
The structural engineer and the designer (who had also the duty of the execution phase co-ordinator) had attended Safety Co-ordination courses and seminar periodically organised by the local order of engineers.
The contractor put in place no particular training system.

11. **Selected conclusions and recommendations**

The second and third stages of the research programme have focused on identifying those key issues associated with appropriate health and safety management strategies for refurbishment projects. Identified key issues involved:

- selection of suitable procurement routes;
- qualified contractors and specialist subcontractors;
- development of structural design information and health and safety plans;
- assessment of method statements;
- Pre-qualification and supervision of workforce on site.

Current procurement routes and professional roles involved in refurbishment projects have been investigated. Health and safety key issues were identified and analysed to give advice in the choice and development of the most appropriate management strategy for a specific site. Refurbishment projects involving partial demolition activities have been specifically investigated. During the design phase of refurbishment projects the Client plays an important role in the selection of structural engineers and designer, therefore the Client is required to:
Provide sufficient time to carry out all structural investigations required to understand the structural condition of the construction to be refurbished;
Choose the most suitable procurement method that is going to affect the management of the whole process.

Most relevant conclusions from the investigation of procurement routes in refurbishment projects were:

- The traditional form of procurement or construction management are the most suggested procurement routes;
- Construction management can provide a greater supervision of the whole process but could be more expensive for the Client;
- Traditional form of contracting requires the Client to appoint a qualified main contractor and to verify the appointment of specialist contractors for demolition activities and temporary works;
- Design and build and demolition as an advanced package cannot be considered amongst the best procurement routes for refurbishment projects;

Those last procurements routes may result in a lack of co-ordination of the different project activities and the Client might find great difficulties in defining responsibilities especially when demolition activities have not been carried under the supervision of the main contractors. The investigation of current management strategies during the execution of refurbishment projects brought to the development of the following conclusions:

- Contractors are required to assess the most suitable demolition methods and select suitable demolition plants and equipments as well as qualified workers;
- Demolition contractors are required to develop demolition method statements that need to be revised and approved by the Project manager and by the Temporary Works Co-ordinator;
- A Temporary Works Co-ordinator should be appointed for the supervision and co-ordination of design and construction of temporary works and the co-ordination of demolition activities;
- Communication between the design team and contractors is essential during all the refurbishment process especially when unexpected findings require design modifications;
- Workers have to be properly informed about project information and contractors should provide regular safety audits and safety talks;
- Communication issues are particularly relevant when dealing with foreign workers and drawing-based safety training materials could be good instruments to overcome language barriers.

Health and safety management strategies can be accurately developed and selected on the basis of the key issues investigated and as reported here. Clients, designers and contractors should consider these key issues and their incidence on refurbishment projects. Help and guidance can be provided in this field through the development of checklists specifically tailored for Clients and contractors.
The structure and the development of such checklists are going to be the specific objective of the fourth stage of the present study. Recommendations for further guidance and/or research will also be made.

12. References:


2. CIRIA Report 172 – CDM Regulations, Practical guidance for Clients and Clients’ agents


4. European Directive 92/57/EEC “Implementation of minimum safety and health requirements at temporary or mobile construction sites”


7. Italian legislative decree n. 528/99 "Implementation of European directive 92/57 concerning minimum health and safety procedures on temporary and mobile sites".


Case studies contacts’ details:

1. Case Study no.1 – Halkin Arcades, Motcomb Street, London, UK
   Case study provided by : Bovis Lend and Lease
   Contacts : Will Taylor, Peter Fielding

2. Case Study no. 2 – Sloane Square Church, Sloane Square, London, UK
   Case study provided by : Walter Lilly contractors
   Contacts : Matt Stagg
3. **Case Study no. 3 – Asprey and Garrad building, New Bond Street, London, UK**  
   Case study provided by: Alan Baxter and Associates  
   Contacts: Robert Bowles, David Johncox

4. **Case Study no. 4 – Residential building, via Gorani, Milano, Italy**  
   Case study provided by: Minotti Costruzioni  
   Contacts: Massimo Minotti (project manager)

5. **Case Study no. 5 – Residential building, via Donizetti, Milano, Italy**  
   Case study provided by: Lomacci Engineering  
   Contacts: Gherardo Lomacci (Works manager, planning supervisor and safety coordinator)
Appendix 4

WP4 Report

“Checklist of issues to consider and areas where further guidance is required”

1. INTRODUCTION ........................................................................................................... 1

2. CHECKLIST OF HEALTH AND SAFETY ISSUES FOR KEY PROFESSIONAL ROLES IN REFURBISHMENT SITES INVOLVING DEMOLITION ACTIVITIES 2

   2.1 THE CLIENT ............................................................................................................. 2
   2.2 THE PLANNING SUPERVISOR .................................................................................. 2
   2.3 THE ARCHITECT ..................................................................................................... 3
   2.4 THE STRUCTURAL ENGINEER .................................................................................. 4
   2.5 THE CONTRACTOR ................................................................................................. 4
   2.6 THE DEMOLITION CONTRACTOR .......................................................................... 5
   2.7 THE TEMPORARY STRUCTURES CO-ORDINATOR ................................................ 6
   2.8 WORKERS .............................................................................................................. 7

3. SUMMARY AND CONCLUSIONS .................................................................................. 8
1. Introduction

The previous stages of the research work have involved the study and analysis of the building process for refurbishment projects involving demolition activities. This study led to the identification of key health and safety factors for the different phases of a refurbishment project: design, planning and execution. The case studies, undertaken as part of the research, provided significant examples of good practice that helped the development of recommendations to improve the health and safety management of refurbishment projects. The relevance of these key health and safety factors, and the related recommendations, can vary throughout the refurbishment stages and needs to be properly addressed to the specific professional figures involved. To highlight the significance of this in a more effective way a checklist of health and safety issues for all the professional figures involved in a refurbishment project has been developed.

The organisation of the checklist has also required the identification of areas where further HSE guidance is required. These areas, that are the not explicitly expressed in the structure of the checklist and have been identified in the intermediate conclusions of the previous reports, are: extension of CDM to refurbishment, education, communication, qualification, design, planning and management.

The extension of CDM requirements, in particular, would include many small refurbishment sites under CDM regulations. This would represent a first step toward a greater commitment of clients and designers in the health and safety management of the project from design stage.

The key functionaries who require further guidance in the management of health and safety issues in the refurbishment sector are:

- Client;
- Planning supervisor;
- Architect;
- Structural Engineer;
- Contractor;
- Demolition contractor;
- Temporary structures co-ordinator;
- Worker;

The checklist developed here can be used to produce health and safety guidance notes whose format strongly requires being direct and concise for the specific user. At the same time the health and safety issues of the checklist can be useful as a scheme for the organisation of the contents of health and safety training courses tailored for refurbishment/demolition sites.

This report includes a brief description of the roles and duties of the figures involved in the health and safety management of a refurbishment project. Tables containing the checklists of issues for every specific functionary will follow the descriptions.
2. Checklist of health and safety issues for key professional roles in refurbishment sites involving demolition activities

2.1 The Client

The Client plays a key role in the whole refurbishment process particularly in the pre-qualification and selection of the members of the design team (Architect, Structural Engineer, Planning Supervisor), and of the contractor/subcontractors employed on site. He/she is also responsible for the decision of the time frame for the refurbishment project. The adequacy of this time provision will allow the completion of all the preliminary structural investigations as well as the reduction of conflicts arising from simultaneous activities.

<table>
<thead>
<tr>
<th>Checklist of health and safety issues for refurbishment sites involving demolition activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subject</strong></td>
</tr>
<tr>
<td>❑ Has the Client been informed about his/her duties concerning health and safety regulations?</td>
</tr>
<tr>
<td>❑ Has the Client appointed a competent engineer and/or architect to develop the design of the refurbishment works?</td>
</tr>
<tr>
<td>❑ Has the Client appointed a competent planning supervisor to develop the health and safety planning of the refurbishment works?</td>
</tr>
<tr>
<td>❑ Has the Client provided to the engineer/architect all the relevant information in his/her possession about the existing building?</td>
</tr>
<tr>
<td>❑ Has the Client provided the engineer/architect adequate time to carry out all the structural investigations on the construction to be refurbished?</td>
</tr>
<tr>
<td>❑ Has the Client planned an adequate time frame for the completion of the refurbishment works?</td>
</tr>
<tr>
<td>❑ Has the Client appointed qualified contractors and specialist subcontractors for the refurbishment works to be undertaken?</td>
</tr>
<tr>
<td>❑ Has the Client selected the most suitable procurement route for the specific refurbishment works to be undertaken?</td>
</tr>
<tr>
<td>❑ Has the Client, once selected the most suitable procurement route, tried to limit the number of subcontracting companies employed on site in order to make workforce co-ordination on site easier?</td>
</tr>
<tr>
<td>❑ Is the Client involved in decisions relating to design changes and made aware of the safety implications of such design changes?</td>
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</tbody>
</table>

2.2 The Planning Supervisor

The role of the Planning Supervisor is mainly concentrated in the design and planning phase of a refurbishment project. He/she is required to develop the pre-tender health and safety plan; therefore all the risks for the construction works have to be identified at the design stage. For a refurbishment project involving demolition activities, the Planning Supervisor has to be fully aware of all the information deriving from preliminary structural surveys as well as the preliminary work related to the development of demolition sequences and temporary works. The Planning Supervisor
Research Project “Health & Safety in Refurbishment Involving Demolition and Structural Instability”

has also to supervise accurately the preparation of the work schedule in order to reduce and/or avoid space-time conflicts.

Checklist of health and safety issues for refurbishment sites involving demolition activities

<table>
<thead>
<tr>
<th>Subject :</th>
<th>PLANNING SUPERVISOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Has the Planning Supervisor been informed about his/her duties concerning health and safety regulations?</td>
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<tr>
<td>☐ Has the Planning Supervisor the requisite experience and competence required to understand specific safety issues involved in refurbishment work?</td>
<td></td>
</tr>
<tr>
<td>☐ Has the Planning Supervisor attended specific training courses for health and safety co-ordination on construction sites?</td>
<td></td>
</tr>
<tr>
<td>☐ Has the Planning Supervisor been involved in the development of all preliminary structural surveys?</td>
<td></td>
</tr>
<tr>
<td>☐ Has the Planning Supervisor been involved in the development of all assumed sequences for construction and demolition activities?</td>
<td></td>
</tr>
<tr>
<td>☐ Has the Planning Supervisor been involved in the development of the preliminary design for temporary works/structures?</td>
<td></td>
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<tr>
<td>☐ Has the Planning Supervisor been involved in the development of work scheduling, identifying any overlap of demolition activities, time/space constraints, etc.?</td>
<td></td>
</tr>
<tr>
<td>☐ Has the Planning Supervisor collated and co-ordinated all project information and adequately highlighted health and safety issues in the pre-tender health and safety plan?</td>
<td></td>
</tr>
</tbody>
</table>

2.3 The Architect

The role of the Architect in the health and safety management of a refurbishment project focuses on his or her ability to effectively evaluate and apply health and safety requirements to design choices. The Architect is specifically required to be able to evaluate the construction implications of his/her design choices; therefore, it is strongly suggested that he/she attends health and safety courses.

Checklist of health and safety issues for refurbishment sites involving demolition activities

<table>
<thead>
<tr>
<th>Subject :</th>
<th>ARCHITECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐ Has the architect been informed about his/her duties concerning health and safety regulations?</td>
<td></td>
</tr>
<tr>
<td>☐ Has the architect received adequate training in order to understand and apply health and safety requirements to design activities?</td>
<td></td>
</tr>
<tr>
<td>☐ Has the architect addressed health and safety considerations while developing design activities?</td>
<td></td>
</tr>
<tr>
<td>☐ Has the architect been able to evaluate, at design stage, the health and safety implications of design choices?</td>
<td></td>
</tr>
<tr>
<td>☐ Has the architect included in the design adequate information about any aspect of the project that may affect the health and safety of people carrying out the works?</td>
<td></td>
</tr>
</tbody>
</table>
2.4 The Structural Engineer

The recommendations expressed for the Architect can be fully extended to the Structural Engineer but with a greater focus on those aspects that relate to him/her. The Structural Engineer has to develop the structural design of the refurbishment project and he/she is required to carry out all the preliminary structural surveys.

These surveys will allow the Structural Engineer to get all the information in order to be able to assume, at this preliminary stage, demolition sequences and the temporary works required. These elements have to be discussed with the appointed contractor and subcontractors possibly during preliminary meetings that are considered essential for instructing all the parties involved on structural changes that may arise on site.

<table>
<thead>
<tr>
<th>Subject: Structural Engineer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has the Structural Engineer been informed about his/her duties concerning health and safety regulations?</td>
</tr>
<tr>
<td>Has the Structural Engineer adequate experience and competence in structural engineering required to understand the structural stability and safety of building elements involved in refurbishment works?</td>
</tr>
<tr>
<td>Has the Structural Engineer received adequate training in order to understand and apply health and safety requirements to structural design activities?</td>
</tr>
<tr>
<td>Has the Structural Engineer addressed health and safety considerations while carrying out structural design activities?</td>
</tr>
<tr>
<td>Has the Structural Engineer, prior to developing the structural design, carried out a detailed and complete structural survey on the existing building?</td>
</tr>
<tr>
<td>Has the Structural Engineer developed possible construction or demolition sequences in order to simulate and verify safety implications while performing the works on site?</td>
</tr>
<tr>
<td>Has the Structural Engineer communicated to all contractors all the information gathered during the preliminary structural survey?</td>
</tr>
<tr>
<td>Has the Structural Engineer communicated and explained the assumed demolition sequences to contractors and subcontractors?</td>
</tr>
<tr>
<td>Has the Structural Engineer organised a preliminary meeting with contractors to instruct them on how to recognise “changes/surprises” and how to deal with them on site?</td>
</tr>
</tbody>
</table>

2.5 The Contractor

The role of the Contractor in the health and safety management of a refurbishment project is extended through all the different stages of the process. When planning the works the contractor is required to:

- Select competent subcontractors;
- Select a competent Temporary Structures Co-ordinator;
• Develop an adequate (and realistic) work schedule analysing conflicts between simultaneous activities;
• Develop an adequate site layout where all the health and safety site provisions are provided.

Prior to the start of site works the Contractor has to inform the workers and, if necessary, provide training about health and safety rules for the specific site. These health and safety audits have also to be periodically repeated during the entire duration of the site works.

<table>
<thead>
<tr>
<th>Subject:</th>
<th>CONTRACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the Contractor aware of his/her duties concerning health and safety regulations?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor been informed about the risks involved in undertaking jobs where he/she is not competent?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor selected competent demolition contractor for the specific refurbishment work to be undertaken?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor selected a competent temporary structure co-ordinator for the specific refurbishment work to be undertaken?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor defined the roles and appointment of the temporary structures' co-ordinator in order to allow him/her to adequately supervise all demolition activities?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor selected skilled workers for the specific refurbishment work to be undertaken?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor selected skilled site managers for the specific refurbishment work to be undertaken?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor developed an adequate schedule avoiding time and space conflicts when carrying out demolition activities?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor provided for constant and adequate supervision of the entire workforce present on site?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor made adequate site provisions for the health and safety of all workers?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor informed the entire workforce about site rules and health and safety information related to the specific site?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor warned the entire workforce about not taking any unauthorised initiative when an unexpected situation arises?</td>
<td></td>
</tr>
<tr>
<td>Has the contractor organised regular health and safety audits with drawings and pictures to overcome language barriers?</td>
<td></td>
</tr>
</tbody>
</table>

2.6 The Demolition Contractor

The Demolition Contractor is a specialist subcontractor who is required to deploy a skilled workforce to undertake specific demolition works. It is also essential that all the additional investigations on the structural conditions of the building to be refurbished be carried out prior to the beginning of the demolition activities. With all the information available the Demolition Contractor can select the most suitable demolition technique and equipment for the specific job.
Great relevance has to be given to the communication of demolition sequences that can be represented through drawing-based method statements.

<table>
<thead>
<tr>
<th>Subject</th>
<th>DEMOLITION CONTRACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Has the Demolition Contractor carried out all the structural investigations in addition to those provided by the Client’s design team?</td>
</tr>
<tr>
<td></td>
<td>Has the Demolition Contractor selected skilled workers for the specific refurbishment work to be undertaken?</td>
</tr>
<tr>
<td></td>
<td>Has the Demolition Contractor selected the most suitable equipment for the specific demolition works?</td>
</tr>
<tr>
<td></td>
<td>Has the Demolition Contractor selected the most appropriate demolition techniques in any phase of demolition works?</td>
</tr>
<tr>
<td></td>
<td>Has the Demolition Contractor developed detailed method statements for demolition activities and communicated them to the Client’s design team?</td>
</tr>
<tr>
<td></td>
<td>Has the Demolition Contractor developed a specific risk assessment and related health and safety procedures for the specific demolition activities?</td>
</tr>
<tr>
<td></td>
<td>Has the Demolition Contractor communicated to the Structural Engineer all the unexpected findings during additional investigations?</td>
</tr>
<tr>
<td></td>
<td>Has the Demolition Contractor discussed the developed demolition method with the Client’s design team and the principal contractor?</td>
</tr>
<tr>
<td></td>
<td>Has the Demolition Contractor informed all workers of risks and safety procedures related to the demolition activities?</td>
</tr>
</tbody>
</table>

### 2.7 The Temporary Structures Co-ordinator

The Temporary Structures Co-ordinator is a new professional role that is not mentioned in the health and safety legislation. It is a new role that the research team considers necessary and the case studies undertaken provided good examples of what is required in this role. The Temporary Structures Co-ordinator is appointed by the principal contractor and some of his/her responsibilities are defined as follows:

- Supervision of the design and planning of partial demolition works and/or of temporary works;
- Management and supervision on site of partial demolition activities and/or of temporary works;
- Communication to all parties involved of all structural modifications that may occur, or that are found, during site works.

The appointment of the Temporary Structures Co-ordinator is strongly suggested for every refurbishment project that involves demolition activities or structural modifications.
Checklist of health and safety issues for refurbishment sites involving demolition activities

<table>
<thead>
<tr>
<th>Subject</th>
<th>TEMPORARY STRUCTURES COORDINATOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Has the Temporary Structures Co-ordinator adequate experience and competencies in structural engineering and temporary structures to understand the structural stability and safety of building elements involved in refurbishment works?</td>
<td></td>
</tr>
<tr>
<td>□ Has the Temporary Structures Co-ordinator received adequate training in order to understand and apply health and safety requirements to temporary works’ design activities?</td>
<td></td>
</tr>
<tr>
<td>□ Has the Temporary Structures Co-ordinator received adequate training in order to manage and supervise the construction and use of temporary structures and the execution of demolition activities?</td>
<td></td>
</tr>
<tr>
<td>□ Has the Temporary Structures Co-ordinator supervised all the changes to the design of temporary structures?</td>
<td></td>
</tr>
<tr>
<td>□ Has the Temporary Structures Co-ordinator adequate control of all structural modifications or changes that may occur during site works?</td>
<td></td>
</tr>
<tr>
<td>□ Has the Temporary Structures Co-ordinator organised his/her work commitments in order to be able to supervise adequately all demolition activities on site?</td>
<td></td>
</tr>
<tr>
<td>□ Has the Temporary Structures Co-ordinator informed the structural engineers of all structural deviations found on site?</td>
<td></td>
</tr>
</tbody>
</table>

2.8 Workers

The workforce has always been assailed as a culprit in the poor health and safety management of any construction/refurbishment site. Workers have to be specifically trained when undertaking jobs involving demolition activities and/or temporary structures. They are required to respect and abide by health and safety rules as well as report any changes in project information. Therefore all project details and information have to be communicated to them at the very beginning of site works and throughout the project, as relevant information becomes available.

Checklist of health and safety issues for refurbishment sites involving demolition activities

<table>
<thead>
<tr>
<th>Subject</th>
<th>WORKERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Have the workers received adequate training for the specific activities to be undertaken on the refurbishment site?</td>
<td></td>
</tr>
<tr>
<td>□ Have the workers received adequate health and safety training and information for the specific activities to be undertaken on the refurbishment site?</td>
<td></td>
</tr>
<tr>
<td>□ Have the workers received adequate training and information to be able to recognise unexpected findings on site and to report immediately to site managers?</td>
<td></td>
</tr>
<tr>
<td>□ Have the workers received an adequate training to be able to receive and act competently and effectively on all the received communications?</td>
<td></td>
</tr>
</tbody>
</table>
3. Summary and conclusions

This report has documented how the health and safety key issues, identified for the management of refurbishment sites involving demolition activities, have been addressed for the different figures involved in refurbishment projects.

The key issues have been grouped in different areas that require further HSE guidance: extension of CDM to refurbishment, education, communication, qualification, design, planning and management. They have also been organised in checklists related to each key figure. Analysing the contents of the checklists it is possible to develop some considerations related to the following key figures:

- **Clients**: Client’s role is pivotal for the whole refurbishment project. The appointment of qualified professionals and the selection of competent contractor and subcontractors will set the tone for a safe completion of refurbishment works.

- **Architects/Structural Engineers/Planning Supervisors**: Client’s design team needs to be more aware of health and safety implications that may arise from design choices. Therefore health and safety issues should be more integrated with design activity.

- **Contractors**: Contractors should be more active in the supervision and co-ordination of demolition activities and temporary works, the appointment of a Temporary Structures Co-ordinator is, therefore, considered essential. Greater efforts have to be concentrated in communicating health and safety rules to workers also setting up suitable communication methods to overcome language barriers.

- **Demolition contractors**: Specialist subcontractors should assess their competencies before taking any job. They have to maintain an active communication flow with structural engineers and designers reporting any structural changes that may occur during site works.

- **Temporary Structures Co-ordinator**: this new role requires adequate co-ordination skills as well as structural and managerial knowledge in order to supervise temporary works design and co-ordinate the execution of demolition activities.

- **Workers**: Enhanced efforts have to be made towards health and safety training. Specific training schemes have to be developed for workers involved in undertaking demolition activities.

The contents of the checklists developed for this report can also provide guidelines for the preparation of health and safety training modules for refurbishment sites or to issue health and safety information leaflets for those figures involved in refurbishment projects (i.e. occasional Clients, designers, workers) that need more HSE guidance.
Appendix 5

WP5 Report

Report on recommendations for further research

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1. Introduction

The research work has identified key health and safety factors whose adequate assessment would improve management of health and safety in refurbishment projects. Management strategies for improved health and safety in refurbishment have also been documented. The investigation of management strategies applied to refurbishment projects led to the identification of specific health and safety issues, which are:

1.1 Selection of suitable procurement routes

Health and safety management strategies can be quite different depending on the specific project, its size and context, activities involved, health and safety issues and the procurement methods. Industry surveys as well as the analysis of HSE accident reports indicate that small refurbishment projects with no specialist refurbishment, or demolition contractors are more likely to have the poorest practices as well as the highest number of accidents. The selection of an appropriate and suitable procurement route is only the first step in implementing an effective health and safety management strategy. The traditional method of procurement (general contractor and specialist subcontractors) can be suitable for refurbishment works but it has to be based on an accurate pre-qualification of demolition subcontractors.

Construction management schemes are characterised by a high level of fragmentation in the design and construction tasks and therefore requires a high degree of coordination in the interface between project activities. The Design and Build procurement route requires the contractor to be responsible for both design and construction of a given project but this kind of procurement route may limit the Client in the project supervision as the contractor takes this role more directly. In demolition as an advanced package the Client develops the demolition and temporary works procurement separately and the Principal Contractor is often appointed after the appointment of the Demolition Contractor. A concern about this procurement route is that the selection methods used by Clients are not as rigorous as those performed by the Principal Contractor. As result of this, demolition contractors are often selected on the basis of the lowest price without considering their qualification or experience.

1.2 Demolition design and planning

The main causes for structural collapses associated with demolition activities can be identified through the different phases of the building process: design, construction, use and refurbishment. Demolition works should be tackled as a whole and as an independent ‘project’ in its own right: a design phase needs to be developed and an execution phase needs to be planned and managed. Demolition works have therefore been divided into three different phases: design, planning and execution. This division provides a significant help in the identification of possible causes for structural instability and in the development of different methods and tools to prevent collapses.

The design phase of demolition works involves both the Client’s and the contractor’s teams. The Client is responsible for the appointment of qualified engineers and health and safety professionals; he/she is also responsible for the pre-qualification and selection of contractors and demolition subcontractors. The Client has also to provide
adequate time and information to carry out all the necessary structural surveys and investigations.

Demolition engineers and Client’s structural engineers have to work together and share their knowledge and experience on the specific project. Demolition sequences have to be developed, revised, updated or changed according to the specific procedures developed by the demolition contractor. The Demolition Contractor will have to prepare method statements prior to undertaking any demolition activity. It is strongly recommended that Safety Managers and Planning supervisors supervise the revision of such methods statements. The planning of demolition activities has to be co-ordinated with the working schedule of the whole project. It is also strongly suggested that all other site works be stopped, to avoid dangerous interferences, during demolition activities.

1.3 Selection and use of plant and equipment:

Prior to the start of any demolition work the most suitable type of machinery and equipment has to be selected and verified for the specific project; the analysis of equipment and tools is also an essential part of the health and safety risk assessment. This is due to the relatively high risk of hazards that the use of electrical or pneumatic demolition equipment involves. Health and safety procedures have to be carefully developed for large machines (e.g. earthworks excavators with hydraulic attachment) as well as for hand-held tools (e.g. demolition hammers). The selection of large equipment will require logistical assessment and the selection of specifically trained users.

1.4 Workforce pre-qualification, selection and supervision:

One of the most important health and safety issues is to use only competent specialist demolition contractors and workers on site. Their experience is vital for the assessment of health and safety problems as well as the development of accurate demolition sequences. The workforce has to be properly trained and qualified to carry out demolition activities, but it is recognised that the construction industry tends to employ many occasional workers with little skills and, quite often, poor knowledge of the native language. The report strongly recommends that workers are assessed for their ability to understand procedures and safety instructions that are communicated to them; at the same time, workers involved in demolition activities have also to be specifically trained on each aspect of the work they are undertaking.

1.5 Communication of project requirements and H & S information

To complete a project safely good communication of all relevant structural and safety information is a key health and safety factor. The communication of project requirements and of health and safety information has to be organised at different stages and at different levels. These stages will be described in the section dedicated to further research in communication topics. Drawing-based method statements can be used to communicate more effectively. At the same time instructions can be given to workers through regular briefings identifying, for specific activities to be performed, possible risks and the related safety measures or procedures. For these kinds of
instructions, that have to be clear and concise, drawings and pictures are strongly suggested.

1.6 Health and safety education and training systems

The health and safety management of construction and refurbishment sites requires all key figures involved to have undertaken a health and safety training. Health and safety training may vary depending on the duties and responsibilities of the figure involved (e.g. 120-hour training course to qualify as a Safety Co-ordinator in Italy, NEBOSH certificate for Planning Supervisors, Safety Co-ordinators and Health and Safety Managers). Construction companies increasingly require all their technical staff to undertake health and safety modules every year. These courses, often organised by in-house training departments, are normally related to the member’s duties and responsibilities.

The study on health and safety issues and the data and information obtained from the selected case studies, which were investigated, led to the identification of topics that were recognised as worthy of further investigation and research. These topics have been grouped into five main areas that are described below:

- The Client’s role
- Communication;
- Education and training;
- Management;
- Decision support

2. Area for further research

2.1 The Client’s role

The Client has a key role in the health and safety management of a refurbishment project. He/she has in fact the following duties/responsibilities:

- The Client, being a single person or a company or firm, is the promoter of the refurbishment project.
- The Client decides the nature of the refurbishment process based on the transformations to be carried on the construction (i.e. structural alterations, change of use, restoration etc.).
- The Client will provide the financing for the execution of all refurbishment works.
- The Client sets the time at the outset of the work to permit the design and procurement phase to be properly developed and to make the necessary allowance for proper investigation of the building where the demolition activities are to be carried out.
- The Client has also to provide all the information he possesses about the existing site.
- The Client is responsible for the decision of the time frame of refurbishment works.
Clients can be divided into two main categories: experienced Clients or frequent procurers and first-time clients. Experienced Clients are those who own or manage a relevant number of properties and have promoted different refurbishment projects or are likely to promote refurbishment projects quite regularly.

The differences between these two categories of Clients are not just based on the amount or value of the refurbishment works promoted. The experience and skills of Clients involved will provide a support for the management of the execution of all refurbishment works.

First time clients are frequently unaware of all the responsibilities involved in promoting a refurbishment work. First of all the European Directive 92/57/EEC, interpreted in the UK with CDM regulations and in Italy with the Legislative Decree n. 494/96, requires the Client to be responsible for the health and safety management of the site of the building for which he/she is the client. Therefore Clients should be provided more detailed guidance on his/her responsibilities as required by the CDM and health and safety regulations. The role of the Client in the refurbishment process should be investigated providing methods to give health and safety information to first time or one-off Clients.

Further investigation should also require the study of frequent procurers and their approach to health and safety management strategies for refurbishment process.

**Specific objectives of further research can be:**

- To investigate the role of Clients in the refurbishment process developing comparisons between occasional and experienced Clients;
- To investigate on a wide sample of experienced Clients the health and safety management strategies applied to refurbishment projects;
- To provide requisite recommendations that can be made available (i.e. through Planning Offices) to occasional Clients;

**2.2 Communication**

All the phases of a refurbishment/demolition process (design, planning and execution) require continuous exchange of information between all the parties involved: Client, designer, structural engineer, planning supervisor, contractor and demolition contractors. In particular the communication of safety information on site can be very difficult when foreign nationals are involved. The communication of project requirements and of health and safety information has to be organised at different stages and at different levels.

The first level to communicate project requirements is within the Client’s team, between the designer (or structural engineer) and the Planning Supervisor, where health and safety problems need to be identified. Where possible, this identification has to be developed at design stage, as a requirement of CDM regulations and Italian Safety legislation. Therefore the communication of design information and of any assumed execution sequence is vital for the Planning Supervisor in order to identify potential risks that can be reduced at design stage. This will result in modification to
parts of the design or in the implementation of specific safety procedures in the pre-construction health and safety plan.

The second level of communication is between the designer, or structural engineer, and the contractor. Project information has to be communicated in detail in order to share the engineering knowledge acquired during the design stage and during preliminary investigations. Communication of design changes between designers and contractors during design is also fundamental. The exchange of information has to be mutual because the contractor, through his experience and skills, may add additional consideration to the project.

The third level of communication is within the contractor and subcontractor teams. Project information has to be communicated to the workforce and the site manager has to ensure they understand site rules and health and safety procedures related to the activities they have to perform. Workers also have to be adequately instructed against taking major initiatives that have not been authorised by site managers. This requires workers to understand project information and that what they may find on site could differ from what was foreseen by pre-construction investigations on the building to be refurbished.

Project information can be better communicated through drawing-based method statements. Instructions can be given to workers through regular brief meetings with workers. During these meetings a given group of activities can be tackled identifying possible risks and the related safety measures or procedures. The instructions given to site workers have to be clear and concise and they have to capture the attention of the audience; therefore drawings and pictures are strongly suggested. Such tools are also more likely to overcome language barriers.

**Specific objectives of further research can be:**

- To investigate current communication methods and strategies implemented for refurbishment sites for projects of different sizes and characterised by different procurement routes;
- To determine the main contents of health and safety information to be communicated and the levels/moments where such information needs to be communicated throughout the refurbishment process;
- To investigate the use of IT tools in the development of drawing/illustration-based communication of health and safety plans, method statements, health and safety audits on sites etc;
- To produce a checklist of key health and safety “communication-contents” to consider in the preparation of health and safety documentation at design and execution stages;
- To make recommendations for all the roles (e.g. Client, planning supervisors, designers, contractors, specialist contractors etc.) involved in a refurbishment project, with respect to effective communication of health and safety information. This could lead to the provision of a Guidance Note.
2.3 Education and training

An adequate health and safety management strategy is mainly based on the qualification of the key figures involved in the selection, development and management of the strategy itself. At the same time health and safety management strategies require all professional roles involved to have appropriate health and safety education.

Education and training provisions should interest not only workers or site managers directly employed on site. Adequate health and safety education and training should be planned for all the parties involved in a refurbishment project.

Workers employed for demolition works should have more requisite skills than other building workers. Basic and current training schemes like, Construction Skills Certification Scheme programme (CSCS) do not fulfil training requirements for complex works such as demolition. Training programmes and the related contents should be investigated and elaborated.

Specific objectives of further research could be:

- To investigate current construction workers training schemes and identify those educational subjects that should be improved for refurbishment/demolition works;
- To make recommendations for the development of professional training schemes for workers and site managers involved in refurbishment/demolition works.

2.4 Management

The selected case studies, which were investigated, provided good examples of how health and safety management strategies on refurbishment projects were implemented by experienced companies. Unfortunately these good practices are not so wide spread among all the construction companies or bodies involved in the refurbishment sector.

The organisation of health and safety documents (i.e. pre-tender health and safety plan, contractor health and safety plan, method statements, health and safety policy etc.) is an effective step forward for better management on site. Guidance for a better development and management of health and safety documents is strongly suggested, also, through integration with communication issues.

Specific objectives for further research could be:

- To investigate current knowledge and usage of health and safety management tools (i.e. health and safety plans, method statements etc) by key functionaries involved in refurbishment work;
- To investigate the significance of current knowledge and usage of safety integrated work schedules;
- To identify key health and safety elements that need to be in construction works schedules;
To make recommendations for the effective usage, update and management of health and safety documents on site as well as their communication to the workforce.

To investigate and document appropriate strategies and means by which relevant health & safety information (in conjunction with other relevant information on a refurbishment project) can be passed on for the benefit of a future refurbishment of the same project. The role of the client and end-user is vital in this regard.

### 2.5 Decision support

The results of the research work confirm that there is need for much greater care in the management of refurbishment works and several suggestions are made for improved industry practice. One of these is the development and use of graphics-based method statements that clearly illustrate how complex refurbishment and/or partial demolition works should be carried out. Another suggestion focused on improved communication of safety information across project team members as well as across stages in the refurbishment project lifecycle.

Further research should focus on the development of a practical decision support system that organisations and individuals involved in refurbishment works could use to make decision in order to perform works safely. Decision support systems (DSS) are tools that provide support to individuals or teams of people that need to make decisions in a given situation. They are often able to draw upon a well-established pool of knowledge about a given domain to offer advice on how to deal with a technical or business problem.

There is currently a shortage of such tools, for the benefit of the refurbishment and demolition sectors. Again, in the main, existing decision support systems appear to be directed towards the needs of new-build construction or aspects of the project delivery process other than for health and safety considerations.

**Specific objectives of further research could be:**

- To investigate and establish the end-user requirements with regard to the development of the decision support system.
- To develop a new process model for refurbishment works, which ensures that safety considerations are taken into account from the earliest stages in the planning and design of refurbishment works.
- To develop a decision support system for avoiding structural collapse on refurbishment works using an appropriate system development environment.
- To evaluate the resulting prototype system with industry practitioners and then to refine the system based on the feedback received.

### 3. Summary and conclusions

This last intermediate report has documented the fifth stage of the research project aimed at the identification of areas in the health and safety management of refurbishment sites that are recognised as worth of further research and investigation.
These areas were identified whilst analysing the key factors and issues that have been recognised as essential in the health and safety management of refurbishment projects.

The role of Client is recognised as pivotal for the whole refurbishment project, however case studies proved that only experienced and motivated Clients are seriously committed to health and safety standards on their projects. One-off or occasional Clients need more health and safety guidance as well as recommendation for the selection of competent professionals for the job they are procuring.

Communication has been identified as a crucial issue for the safe completion of a refurbishment site. A continuous flow of information has to be maintained between all the figures involved in the refurbishment process. Further research should focus on communication methods to educate and train the workforce. The case studies undertaken in the research project provided good example on how drawing based method statements could be better communicated and understood. IT tools have also the potential to provide good support to communication issues.

More efforts should be put in developing specific training schemes for workers involved in demolition activities; format and contents of such schemes can be a topic for further research work.

Case studies and HSE accident reports proved how the implementation (or the absence) of a management strategy could affect the health and safety of a refurbishment project. Further investigation on current management strategies is recommended, in particular it should focus on health and safety management tools as safety plans, method statements, work schedules etc.

More advanced research could focus on the development of decision support systems applied to refurbishment sites. These systems would ensure that safety considerations are developed for the very beginning of the design stage in order to avoid structural collapses.

It is evident from the conclusions developed so far that there are many possibilities of further research in the refurbishment sector. The research areas identified can also be easily built on the results drawn from the present research project. These results would help the research activity providing the methodology and using the already developed research experience as well as the contacts for additional case studies.