The Appraisal and Management of Multi-storey Dwelling Blocks Using Large Concrete Panel Systems

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Doctor of Philosophy

THE UNIVERSITY OF ASTON IN BIRMINGHAM

June 1989

The University of Aston in Birmingham

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Thesis Summary

This exploratory study is concerned with the integrated appraisal of multi-storey dwelling blocks which incorporate large concrete panel systems (LPS). One hundred of the multi-storey dwelling blocks under the management of Birmingham City Council were built using the large concrete panel system. Thirteen LPS blocks were chosen as case-studies depending mainly on the height and age factors of the block.

A new integrated appraisal technique has been created for the LPS dwelling blocks, which takes into account the physical and social factors affecting the condition and acceptability of these blocks. This appraisal technique is built up in a hierarchical form moving from the general approach to particular elements (as a tree model). It comprises two main approaches; physical and social appraisals.

In the physical approach, the building is viewed as a series of manageable elements and sub-elements to cover every single physical or environmental factor of the block, in which the condition of the block is analysed. A quality score system has been developed which depends mainly on the qualitative and quantitative conditions of each category in the appraisal tree model, and leads to ranking order of the study blocks.

In the social appraisal approach, the residents' satisfaction and attitude toward their multi-storey dwelling block was analysed in relation to biographical and housing related characteristics; and social, physical and environmental factors associated with this sort of dwelling, block and estate in general. The random sample consisted of 268 residents living in the 13 study blocks. Data collected were analysed using frequency counts, percentages, means, standard deviations, Kendall's tau, r-correlation coefficients, t-test, analysis of variance (ANOVA) and multiple regression analysis.

The analysis showed a marginally positive satisfaction and attitude toward living in multi-storey dwelling block. The five most significant factors associated with the residents' satisfaction and attitude in descending order were: the estate, in general; the service categories in the block, including heating system and lift services; vandalism; the neighbours; and the security system of the block.

An important attribute of this method, is that; it is relatively inexpensive to implement, especially when compared to the alternative adopted by some local authorities and the BRE. It is designed to save time, money and effort, to aid decision making, and to provide ranked priority to the multi-storey dwelling stock. In addition to many other advantages.

A series of solution options to the problems of the blocks was sought for selection and testing before implementation. The traditional solutions have usually resulted in either demolition or costly physical maintenance and social improvement of the blocks. However, a new solution has now emerged, which is particularly suited to structurely sound units. The solution of " re-cycling " might incorporate the reuse of an entire block or part of it, by removing panels, slabs and so forth of the upper floors in order to reconstruct them as low-rise accommodations.

KEY WORDS: Multi-storey dwelling block, Physical Appraisal, Social Appraisal, Large Panel Systems and Re-cycling.

بسم الله الرحمن الرحيم

In the name of God, Most Gracious, Most Merciful.

((قالوا سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم.))

((They said: "Glory to Thee : of knowledge
We have none, save what Thou
Hast taught us : in truth it is Thou
Who art perfect in knowledge and wisdom."))

Sura II (THE HOLY QURAN)

الى الذي سكبت انامله الروائع
ورصّع مساجد الله بالبدائع
الى المدرسة والابداع في الخط العربي علما وفنا
والدي ومعلمي الاستاذ يوسف ذنون ..
اهدي هذه الرسالة .. برّا وعرفانا ..

TO MY FATHER.. YOUSUF THANNON.. I DEDICATE MY THESIS.

Acknowledgements

The author wishes to express sincere gratitude to many people whose help and support were essential for the fulfillment of this study, namely:

1. **Dr. D. C. A. McLeish:** Special thankfulness is expressed to Dr. McLeish for his continuous advice, encouragement, invaluable suggestions, untiring guidance and supervision during the development of this research.

2. **Dr. T. R. E. Chidley:** Recognition is also expressed to Dr. Chidley, who in his own research expertise and experience, provided valuable suggestions and constructive criticism.

3. **Mr. F. Chilton:** A sense of obligation is owed to Mr. Chilton, the head of Architects Department in the City of Birmingham, for his skillful advices, subject matter expertise, support, checking writting-up and friendship throughout during the development and implementation of this study.

4. The Ministery of Higher Education and Scientific Research of the Republic of IRAQ for their financial support, and to the Cultural Department in the Iraqi Embassy in London for their financial supervision during this study.

The author wants to express gratitude to his best friend; Dr. K. Y. Abid for his support, evaluation and assistance in data collection. Also, to his colleagues Mr. A. Jones, Dr. H. Hanif and Mr. G. Bawa for their good company and co-operation.

Special gratitude is owed to Dr. A. Hedge, Dr. W. G. Cumberbatch (Applied Psychology Division - Aston University) and Mr. N. Al-Talib (University of Birmingham) for their advice in the social and statistical parts of this study.

In addition, the author wishes to express his gratitude to Housing Officers, Caretakers, Wardens and Tenant Associations of the study blocks, and to the all respondents who so willingly participated in this study in the City of Birmingham and in the 13 case study blocks.

A warm gratefulness is extended to the author's parents, brothers and sisters for their support, encouragement and source of inspiration throughout the period of this study. Special mentioned is owed to my father for his continuous advices and to my oldest brother Osam for his valuable helps in many occasions.

Finally, a special gratitude, but not least important, is extended to the author's wife Ms. Nada M. Juma, for her patient, support, encouragement, understanding and source of inspiration throughout the all period of this study, an essential factor for the fulfillment of the research. Extended to my son Yasir and my daughters Zaynab and Ruqaiya.

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INTRODUCTION

1.1 Preface

Providing adequate dwellings for people is one of the great problems in the world today. In many places it is the lack of adequate places to live combined with the lack of jobs that is causing the desperation, riots and general social upheaval characteristic of life in even the most advanced countries.

In Britain, a major part of the public building industry had changed radically in the twenty years following the Second World War. In place of the traditional collection of crafts an "industrialised building" industry was emerging in which the main driving forces were speed of construction, mass production, low cost per unit and unified control of the whole process from conception to detailed realisation and hand-over to the users. Side by side with these changes in the 'means' of the construction industry was a constant change in its 'ends': people's requirements of and use of building were varying continually and there was a rapid decline in positive attitudes toward this type of buildings.

In Birmingham, as a reaction to the chronic housing shortages of the late 1950's and early 1960's the Evening Dispatch (6th April 1960) called for, "really high building .... tall towers 20, 30 or 40 storeys high to release more space for sweeping parklands in the new Birmingham". These pressures led to prolific growth of high-rise constructions in Birmingham during the mid to late 1960's. The City Council decided to use Large Concrete Panel Construction, as a major component of its House Building Programme and subsequently over one hundred Bison Wall Frame (WF) and Fram tower blocks were built.

It soon became apparent that these blocks were not the ideal solution, with both physical and social problems being reported. Not only had it become less financially advantageous to build multi-storey housing but it was well known that tenants preferred normal houses to 'prisons in the sky'. Damp and condensation were recorded as early as 1967; in response to this for instance, Bryant's Directors agreed to "accept full responsibility and carry out suitable preventative measures, entirely at their own cost, having indemnified the corporation for 60 years against any possible loss due to the recurrence of this trouble" (Birmingham House Building Committee minutes, 6th July 1967). These defects were not completely repaired, some of these and other problems have since re-occurred and solutions still remain to be found, and a comprehensive appraisal technique is required. This thesis is concerned with developing such a technique for large panel system dwelling blocks.

1.2 Background:

Before 1900, government took little responsibility for housing, but since the turn of the century it has played varying roles in different nations. After the Second War World most of the countries of Western Europe, devastated by depression and war, were no longer willing to accept the word of their "men of affairs" that private enterprise should go it alone as far as housing was concerned. An intensive programme of government aid for housing was begun in the alternative forms of:

1. municipal housing;
2. governmental housing;
3. housing co-operatives;
4. union housing;
5. subsidies to individuals and municipalities; and
6. provision of housing for special groups[1].

Great Britain has afforded the greatest degree of local autonomy among the European nations and council housing had been developed into the largest local authority housing programme in the world. In some areas, such as Scotland and Birmingham, council housing constituted almost one-half of all housing built.

The form of construction used by councils varies with local conditions. Large local authority housing programmes played an important part in making the industrialisation of house building possible. During the 1960's the purchasing power of councils led to rapid growth in the building of towers of flats of ten storeys and more of large concrete panels. At the beginning of 1970's, for several reasons (see Chapter Two), this technical innovation suffered a further set-back. Efforts were accordingly switched to simplifying the construction of low-rise and terrace houses in order to obtain economies in cost and greater speed of erection.

A Department of the Environment (DoE) survey [2], published in November 1985, reports that there are nearly four million council dwellings requiring an expenditure of £18.84 billion (an average cost of £4,900 per dwelling) for a long term programme of repairs. Of particular concern are buildings of large load-bearing, pre-cast concrete, panel construction. Central records of approval and construction indicate that some 140,000 dwellings of this type were built and that around one billion pounds is needed for their repair.

In late 1984 the DoE requested further details as to the ownership and condition of large panel systems of construction[3]. The subsequent returns were analysed by the Building Research Establishment (BRE) and showed that only 78,703 dwellings (more than 1200 multi-storey dwelling block) had been identified by the survey. Some of this discrepancy can be attributed to demolition, however a large part was due to Housing Authorities failing to reply to the survey (in some instances such as Birmingham, the City of the biggest stock, felt unable to reply as they owned blocks of hybrid construction requiring detailed investigation before they could be categorised).

Having identified the need to investigate the condition of large concrete panel system built dwellings in the United Kingdom. It was decided to limit this investigation, for the purposes of study to the tower blocks found in Birmingham. This is because the City of Birmingham owns the largest number of such blocks in England. Over a hundred of these have been constructed using the large panel system. For the purposes of this research, the following definitions have been assumed:

Tower Block (or Block): A group of council owned dwelling units of over five storeys, or multi-storey dwelling block.

Large Panel Systems(LPS): Dwelling units constructed of large load-bearing pre-cast concrete panels which form the structural frame.

Today, there is an increasing interest in the appraisal of existing large panel blocks. This interest is mainly in achieving cost effectiveness, and many of these blocks are thought to be in need of urgent attention.

So, the question is; do these blocks really need this urgent attention, and what are their real physical defects and social problems? If there are problems, what are the possibilities of solutions? Is it a good idea to demolish all the LPS blocks, to dismantle them carefully and re-erect the sound components (after some treatment and modification) in the form of low-rise developments (termed re-cycling; a new alternative solution investigated and discussed by this study) or just to maintain them with very high running cost, and which block should have priority? This research is the first to investigate and discover these physical and social factors which concern LPS blocks in Birmingham. This is done by collecting all available data and by creating a new, simple and inexpensive integrated appraisal technique to discuss all the alternative solutions according to the physical defects and social problems.

This integrated appraisal technique comprises two main approaches; physical and social. In the physical appraisal approach, the study of the structural, finishes, services and environmental defects will expand the knowledge about the main physical defects of that form of dwelling and suggest possible rational solutions. DoE and most local authority studies have concentrated only on the structural condition of LPS blocks, which represents only one part of the physical aspect of these blocks in any remedial decision. These studies proved that the structural condition of the LPS block was satisfactory (sound and safe). This study will also highlight other physical aspects, that is finishes, services and environmental factors which are collectively more important than just the structural aspects of the block.

In the social appraisal approach, the study of residents' satisfaction and attitude toward LPS blocks and the physical and social factors associated with that satisfaction are very important for any inclusive appraisal. This study is concerned with the problems of that form of accommodation and suggest possible explanations for people's reluctance to accept this form of housing. The main questions concerning this approach are: what causes residents to complain about living in LPS multi-storey dwelling blocks? what physical, environmental and social aspects are related to living in a LPS multi-storey dwelling block associated with residents' satisfaction and attitude? and which are most significant?

This study is designed to answer these and other questions related to multi-storey dwelling blocks using large concrete panel systems. The following section identifies the main objectives of this study:

1.3 The Objectives of the Study:

The main objectives of this research are:

1. To collect and record as much information as possible about multi-storey dwelling stock in Birmingham in general and LPS blocks in particular, in order to provide a better understanding of their conditions.
2. To create a relatively simple and inexpensive physical appraisal technique for LPS blocks.
3. To create a simple social appraisal technique for these blocks.
4. To provide priority ranking of these LPS blocks in terms of physical and social influences, for any possible solution in the future.
5. To investigate and discuss economic and durable alternative solutions.
6. To study the viability of re-cycling the sound components of these blocks (as low-rise buildings) as a new alternative to solutions adopted to date.

The integrated appraisal of these blocks will comprises two main areas for analysis:

A. Physical Appraisal Approach:

The primary objectives for the physical appraisal are:

1. To appraise the structural condition of each block. (a quality score will be obtained for the structural condition).
2. To appraise the condition of finishes for each block. (a quality score will be obtained for the finishes condition).
3. To appraise the condition of the services within each block. (a quality score will be obtained for the services condition).
4. To appraise the environmental factors which affect each block. (a quality score will be obtained for the environmental condition).
5. To appraise the physical condition of each block. (a quality score will be obtained for each block depends mainly on the quality scores for each components mentioned above).

6. To obtain the final integrated appraisal result for each block by accumulating the physical and social Appraisal results.

B. Social Appraisal Approach:

The primary objectives for the social appraisal are:

1. To identify and describe the demographic factors relating to the residents of the chosen study blocks.
2. To examine the residents' satisfaction and attitudes toward the dwelling and dwelling categories. (a social quality score will be obtained for the dwelling and dwelling categories).
3. To examine the residents' satisfaction and attitude toward the block and blocks' components. (a social quality score will be obtained for the block and block components).
4. To appraise the effects of the estate and other factors relating to the social condition of each block.
5. To examine the individual and collective contribution of the physical and social variables on the residents' satisfaction and attitude toward their multi-storey dwelling block.
6. To appraise the social condition of each block. (The final score will be taken as a percentage rate and depends principally on the main dwelling and block categories).
7. To obtain the final integrated appraisal results for each block by accumulating the social and physical results.

1.4 Rationale for the Social Study:

Architects and designers have long known that the form and appearance of a building influence certain behaviour that takes place within it. Historians of architecture have noted that man's dwelling places in every country reflect the sociocultural values of the time and place. When men build houses, they create not only a physical environment but a psychological and social environment, a symbolic world that reinforces a particular scheme of tastes and values.

In 1963, John Noble wrote an article in the Architects' Journal entitled "The How and Why of Behaviour : Social Psychology for the Architect", in which he wrote:

> "as architects we help to shape people's future behaviour by the environment we create."[4]

This interest of the architects and designers in psychological and social sciences has its basis in the simple, but important fact that: it is impossible to conceive of buildings independently of the human activities they serve. Rarely can an architect or designer talk about his plan without making repeated references to what people will do in his buildings or how they will move through them.

Supporting what Noble wrote, Gutman (1975) discussed in his paper the importance of sociology in the architect's planning and design. In which he said:

> " It is important that we understand just how necessary sociology is to the architect who is willing to make his design accord with user's objectives "[5]

Such a belief very widely held amongst architects and one of great importance not only to them, but also to the human scientists for the benefit of the public in general. Architects, psychologists and sociologists spend a great deal of time defining and examining the concept of "environment" and in describing the influence of the environment on the human being[6,7,8].

Due to this important relationship, any researcher who attempts to make a comprehensive appraisal of any existing building (especially public multi-storey dwelling blocks) must take into account the influence of social factors.

A very good example and one of the most thoroughly investigated breakdowns of social order in multi-storey public dwelling occurred is the Pruitt-Igoe housing project in St. Louis, Missouri, USA. The Pruitt-Igoe housing project consists of 43 eleven storey buildings. It was opened in 1954 with 2,762 apartments. The project community was plagued by petty crimes, vandalism, a constant sense of fear and distrust, much destruction to the physical plant and had a widespread reputation as being an extreme example of the pathologies associated with lower social classes[9]. From its inception, the project failed overwhelmingly to meet the social needs of its residents.

The Pruitt-Igoe housing project, which had received architectural awards for its design, was razed to the ground in 1972, less than twenty years after its completion. In 1971, William Yancy conducted a series of interviews with residents of Pruitt-Igoe in an effort to discover why the project had failed so totally as a human habitat. He found the Pruitt-Igoe lacked the cohesion, social order and mutual support that had been found to characterise many central-city neighbourhoods[10]. Here is a very famous example of the rationale of the social factors which is behind the success or failure of any project design or appraisal.

In Britain there is much evidence of the importance of these considerations; a good example here in Birmingham is Castle Vale, a town-sized development for 25,000 people. It was opened in 1965 with full benefit of planning, including 11-storey and 16-storey blocks. But by 1981 it had became so unpopular, that one third of its dwellings were empty[11]. This was mainly due to the management and the associated social problems.

1.5 The Constraints and Limitations:

Various constraints have formed and shaped this study. The most important of these are:

1. the multi-dimensional and politically controversial nature of the subject;
2. the scarcity of relevant information and data relating to each case study block;
3. In the social appraisal, most of the trials to gather some more information had no responses; and
4. The strictly limited resources available to accomplish the survey even for the restricted sampling undertaking.

In this sort of study, it is common to take many years using a multi-disciplinary team of researchers, rather one person, to properly develop and propose new ideas for the integrated appraisal of multi-storey dwelling blocks.

1.6 The structure of the Thesis:

This thesis is arranged in a way which follows the development of the components forming the thesis. On that basis, this study is divided into four parts:

1. Introduction;
2. Appraisal technique;
3. Results and discussions; and
4. General conclusions and recommendations.

The introductory part (chapters 1 to 3 inclusive) constitutes both the introduction and background to the main core of the study, in addition to the literature review. The chapter following this one, comprises a general review of the concept, origins, types and end of the industrialised building in Britain, thus providing a substantial background. It is based on an extensive survey of literature, covering a wide spectrum of books and articles on the subject. A special review on the multi-storey dwelling blocks in the City of Birmingham was conducted. Chapter three is devoted to the theoretical and practical approaches to public housing appraisal which had previously been employ. Additionally, an interesting recent development solution (re-cycling) is also reviewed.

The appraisal methodology of the new integrated appraisal techniques (physical and social) is discussed in chapter four. In it, the most important information about the 13 case study blocks is reported.

Chapter 5, 6, 7 and 8 consist of the main physical and social results and discussions. Chapter 5 deals with results and discussions of the physical appraisal. Chapter 6 and 7 deal with results of the social appraisal and the discussions of these results statistically, where the general integration of results from the physical and social appraisal approaches in terms of the final results used in the ranking technique are presented in chapter 8, with a brief discussions of the main results of each case study block.

Chapter 9 deals with the main alternative solutions. This concentrated on five options for solutions, namely: the physical improvement, the social improvement, the re-cycling, partial demolition and total demolition.

An attempt to synthesize the general conclusions of the research together with the summary of main physical defects and social appraisal findings, some suggestions and recommendations for future studies are mentioned in chapter 10 at the end of this study.

Chapter Two

INDUSTRIALISED BUILDINGS

The purpose of this chapter is to provide a background knowledge on the concept, the origins, the classification and the failure of industrialised building systems, specifically in the United Kingdom. In doing so, the aim is to bring the variety in this field to light and emphasize the main characteristics in each category of these systems. It is intended to give as full an account as possible of industrialised building systems, for the purpose of further appraisal studies. The emphasis will be on the high-rise blocks that incorporate large concrete panel systems, which are the main concern of this study.

2.1 The Concept of Industrialised Building:

Industrialisation itself can be defined as a production method, based on organised and often mechanised processes of a repetitive character[12]. It is therefore a method and not a product. The most comprehensive definition of industrialisation was given by the United Nations[13], as follows:

> " A continuity of production, implying a steady flow of demand, standardisation, integration of the different stages of the whole production process; a high degree of organisation of work-mechanisation, research and experimentation integrated with production."

The use of the term industrialisation in connection with buildings, is to indicate a non-traditional building activity. In general usage, the expression industrialised building corresponds with prefabricated or precast building. The definition of prefabrication, or precasting in any building can be stated as: carrying out any part of the whole building operation separately from the process of placing materials or components, in their final position in the building on the site[14]. These items can be either manufactured with on-site plant or at off-site location as factory made components. With regard to this, it can be said that industrialised building is considered as a dry method of construction, where as traditional systems (in-situ) are often described as wet systems.

The United States Ministry of Housing's definition[15] of "industrialised building" is: " All measures needed to enable the industry to work more like a factory industry. For the industry this means not only new materials and construction techniques, the use of dry processes and the manufacture of large components under factory conditions of production and quality control, but also improved management techniques, the correlation of the selection and delivery of materials, and better organisation of operation on site."

The perception of industrialised building has also differed from country to country. A leading Hungarian expert has suggested in his book, that industrialised buildings includes the following characteristics[16]:

1. large scale use of machines;
2. large scale factory produced components;
3. large scale projects constructed by repetitive process;
4. co-ordination of management, which leads to efficient planning and control of projects; and
5. continuous research in design and production systems.

It can be inferred from this suggestion that one of the principal characteristics of industrialised building is large-scale planning, based on repetition of processes. This is regarded as one of the key factors determining the success of the industrialised buildings[15].

Consequently, there is no generally accepted definition on which this sort of work could be based. Therefore, the term " industrialised buildings" will be used to refer to those buildings excluding traditional buildings, which are based completely on handicraft processes.

2.2 The Beginning of industrialised building:

Industrialised buildings can be traced back to the late 19th century[17]. They initially involved the casting of floor and beam components. At the beginning of the 20th century, wall panels and columns were also cast. In fact, the construction involved individual buildings only. The standardisation and mass-production for large projects (especially for dwellings) were not introduced until after the Second World War.

Industrial change and technological innovations have affected the building industry radically in the score of years since the Second World War. In Britain, the shortage of housing after the War, particularly for low-income groups, also stimulated need for changes in the building industry. Consequently, in place of the traditional collection of crafts, the industrialised building industry emerged. In which the prime driving forces are:

1. economics;
2. demand for housing;
3. reduced construction period;
4. limited availability of skilled labour;
5. all-weather construction;
6. Mass-production; and
7. unified control of the whole process from conception to detailed realisation and hand-over to the users.

There was an integral relation between industrialisation and high-rise buildings[18]. The 1960's industrialised boom which began in mid 1962 focused initially only on high-rise buildings. Table 2.1 shows high and low-rise industrialised buildings between 1963-1973. The growth in importance of high flats was maintained by the much more extensive and rapid industrialisation of high-rise building, amounting to two-thirds of all high flats by 1967, around twice the figure achieved for low-rise buildings.

Year	Industrialized High-rise		Industrialized Low-rise		% of Indust. housing in high flats
	Numbers	% of all high-rise	Numbers	% fo all low-rise	
1963	11,072	40.3	na	na	na
1964	14,787	41.7	na	na	na
1965	16,613	47.5	28,715	22.5	36.7
1966	24,342	52.4	40,553	31.6	37.5
1967	26,298	66.9	44,860	34.2	37.5
1968	19,192	62.7	39,393	31.8	32.8
1969	11,907	78.2	22,859	23.6	34.2
1970	1,983	20.4	17,399	19.7	10.2
1971	2,757	34.4	14,877	17.5	15.6
1972	1,940	26.2	12,922	18.1	13.1
1973	674	27.0	21,748	27.3	3.0

Table 2.1 High- and low-rise industrialized buildings, 1963-1973 [19]

The importance of high-rise in the industrialised market is indicated by the more general decline induced by the collapse of the industrialised high-rise market after 1968-69 (seen in Table 2.1). Industrialised systems with a high-rise capacity were far more successful in securing orders than exclusively low-rise systems until 1968 [19].

2.3 The Classification of industrialised building systems:

There are a large number of industrialised building systems all with different characteristic features. Consequently it is a very difficult and complex task to develop a classification in which each type of system can be systematically appraised. At present, many classifications of industrialised building systems are available on the basis of differing criteria. They have been considered under such headings:

1. Non-traditional systems:
2. Rationalised systems:
3. Modern in-situ systems;
4. Prefabricated systems;
5. Semi-industrialised system;
6. Large panel systems building, and so on.,

all of which lend themselves to various interpretations.

This variety in industrialised building systems can be illustrated by looking at these systems from different angles. The many overlapping characteristics and confusing categories in existing classification are revealed. The main headings on which classification in this study is based are:

2.3.1 The Degree of industrialisation:

The following categories can be identified on the basis of the above criteria:

1. Rationalised traditional building systems:

   The degree of divergence from the traditional building systems is small.

   Such a system is generally regarded as a traditional one.

2. Partially industrialised building systems:

Most elements of the construction are prefabricated and are assembled together on site. The processes are of an assembly, erection and finishing character. However, some operations still remain to be performed on site.

3. Totally industrialised building systems:

Constructional elements are totally prefabricated and only assembly and erection operations take place on site.

2.3.2 The distribution of roles in industrialised buildings:

Industrialised buildings result from co-operation between the client, architect, engineer, manufacturer and the contractor. Not only at individual stages of development, but right from inception through to the completion of the building[20]. Regarding the pattern of relationships between the parties involved in industrialised building , commonly there are two categories into which industrialised building systems can fall. These are:

1. "Closed" industrialised building systems:

A building system is termed "closed", if components, connections and packings are designed and limited in use to that particular system. Consequently the floor plans, facades, wall thicknesses and materials are very much restricted in design. Closed systems are ,however, well suited to mass production and erection. This is the approach most commonly used for multi-storey dwelling blocks and certain types of industrial buildings[21].

2. "Open" industrialised building systems:

Due to the limitations of choice in closed system building, international effort has been made by various establishments to develop a dimensional co-ordination of buildings and building components[22,23]. The development of standard jointing details has been more difficult[17]. The design procedure may be summarised as follows:

(a). The design concept should be adjusted to conform to the nationally agreed dimensional standards.

(b). The functional requirements of the structure must be clearly set down.

(c). The structure must be divided into components and the performance requirements of each of these must be identified.

(d). The components and initial divisions must be adjusted in order to satisfy a system component specification.

2.3.3 The Characteristics of industrialised building:

The industrialised building systems can be identified according to the following criteria:

1. The weight of prefabricated elements:

   Which are divided mainly into:

   a. Heavy prefabricated building systems : The term " Heavy prefabricated" indicates a building element heavier than 500Kg. with a plan area over $2m^2$[24]. In this system, generally wall and floor elements consist of this type of heavy component.

   b. Light prefabricated building systems: In this system, wall and usually floor elements consist of small and light prefabricates, not exceeding 500Kg. in weight with plan areas below 2 m^2[25]. Compared to the previous systems with heavy building elements, the sophistication of technology and industrial processes involved, are reduced.

2. The place of manufacturing process:

   Which are divided mainly into:

   a. Off-site industrialised building systems: The manufacturing process for building elements is in permanent plants established especially for this purpose. The location of the plant is remote from the building plot.

b. On-site industrialised building systems: In these systems, components are manufactured in an on-site plant. Because of the temporary nature of site-work, a high degree of mechanisation similar to that used in an off-site permanent plant can not be economically provided.

2.3.4 The Design and Layout Characteristics of industrialised building systems:

A more useful and comprehensive division of industrialised building systems can be made with respect to design principles and the structural layout of the building. Two main types are as follows:

1. Frame-type structure:

   This type comprise linear load bearing components and floor slabs combined with light non-loadbearing wall panels and partitions for space enclosure. These type of structures allow great variations in plan layout and choice of cladding, which do not necessarily have to be made of concrete.

2. Panel-type structures (Large panel systems):

   This type usually consist of large loadbearing wall panels and floor slabs. Several functional requirements are simultaneously served by each component. This type of structure is most commonly used for residential buildings, i.e. where no great changes in functional requirements of the building are expected during its life. Flexibility of panel construction is most likely to be achieved if adjustments to or variations in moulds from one job to the next can be made[26]. This type of industrialised building will be dealt with more thoroughly in the next section for the purpose of this research.

2.4 Large Panel Systems:

Large panel systems of construction were used in Europe and the United States of America from 1920 onwards[27]. However, conditions favourable to large panel construction had arisen in several countries during the 1950's and 1960's, often through the need for a rapid expansion of building programmes. Large panel methods made this possible through relying on unskilled labour for the main part of the work, both in the factory and on-site.

In the United Kingdom, cheap bricks, relatively cheap labour and inadequate programming of site work, all contributed to delay in the introduction of industrialised building systems, but which finally emerged in the years of upheaval following the Second World War. Despite this, Reema construction company were pioneers in large panel systems in the field of municipal housing, low-cost speculative housing and in multi-storey dwelling construction[27]. Subsequently many other contractors in the United Kingdom, such as: Concrete Limited*, Taylor Woodrow-Anglian Limited, Fram, Camus (Great Britain) Limited and others, had employed precast concrete elements in construction.

Concrete Limited started to manufacture precast concrete floors in 1919. This was one of the world's first attempts to produce a standard precast concrete unit which would be sufficiently adaptable to be used in any type of building, regardless of size or amount of repetition[28]. For their trade-mark they chose a Bison, as representing speed and strength. In 1956, the first nine-story blocks of flats were constructed using the Bison system. It employed wide floor slabs with precast concrete beams and columns[29]. Later on, five plants were built for the manufacture of the Bison Wall Frame system throughout Great Britain. This Bison Wall Frame system was specifically designed for multi-storey dwelling blocks. Normally the blocks would be between eight and twenty storeys in height, with

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* The concentration has done on the Concrete Limited company because most of this research case studies are belong it(i.e. Bison Type).

four, six or eight dwellings per floor. For more details about Bison system, see Appendix I.

Recently, BRE, in their investigation of the problems of large panel systems of construction, published a report on the preliminary information on ownership and condition of large panel system dwellings[3]. The information for the report were received from 328 local authorities, new town development corporations and other bodies in England. In some 65 English local housing authorities, information was not supplied. The responses from Northern Ireland, Scotland and Wales are virtually complete. Table 2.2 shows the summary of analysis of returns by most important systems and the number of dwellings by block height.

According to the BRE information (shown in Table 2.2), the number of large panel blocks constructed by Bison WF system in United Kingdom is in excess of 500 blocks. This includes the Birmingham stock (100 large panel blocks, 90 blocks of Bison WF system and 10 blocks of Fram system). They represent more than 40 per cent of the total number of large panel blocks in the United Kingdom. Bison WF system represents the largest percentage of these, especially in Birmingham. The next section will deal with the Birmingham stock, in general, and large panel blocks in particular.

Construction System	Number of blocks / Number of dwellings		
	England	N. Ireland Scotland & Wales	Total for system in U. K.
A & C Barvis	1/ 44		1/44
Beale and Son	4 / 360		4 / 360
Bison (42-Birmingham)	264+/18886+	147/7588	411+/26474+
BRS " Battery cast"	5 / 349		5 / 349
Camus (5)	42 / 4489		42/4489
Cebus	8 / 621		8 / 621
Crudens Skarne		120/4400	120/4400
EDLO	11/ 1508		11/1508
Fram Russell (2-B'ham)	13+/1188+		13+/1188+
GLE	2 / 130		2 / 130
Harley Haddow		12/1124	12 / 1124
Harry Neal "battery cast"	3 / 170		3 / 170
Jesperson 12M (7)	33+/2925 +	20/480	53+/3405
Lecaplan (1)	11 / 296		11/296
Mitchell Camus		14/672	14/672
Reema (25)	15 / 1200+	34/3341	49/4541+
Selleck Nicholls Williams	9 / 750		9 / 750
Shepherd Spacemaker	4 / 220		4 / 220
Skarne (crudens) (5)	41 /1885+		41/1885+
Tracoba	9 / 1580	28/1996	37 /3576
Taylor Woodrow Anglian.15	99 / 6278+		99/6287+
Wates (8)	76 / 4886+	2 /206	78 /5092+
Weedon	1 / 94		1 / 94
Yorkshire Dev Group (1)	33 /1185		33 / 1185
Unknown (or one offs)	12 / 950		12 / 950

Table 2-2 Summary of main large panel systems in the U. K. (over 5 storeys)[3]

2.5 Multi-storey Dwelling Blocks in Birmingham:

2.5.1 Historical Background :

The Birmingham area covers about 65,000 acres (approximately 102 square miles), largely occupied by industry and housing. It has largest population outside London with more than one million (1,013,000 in 1971 census*). The physical structure of the city has undergone significant change since the Second World War. Housing is one of the most important areas with which the Local Authority has to deal. During the War years there was little house building or repair activity. Over 5000 homes were totally destroyed within Birmingham's boundaries due to the heavy bombing of this industrialised city[19].

After the War, Birmingham had a very large housing problem. In fact, there were more than 50,000 people on the housing waiting list, in addition to serious problems within the existing stock,that was often characterised by decay and obsolescence.

The problem was partly solved at the end of 1940's, by using "prefabricated dwellings", which could be erected in about two weeks, with an intended lifetime of 5-7 years[30]. But at the beginning of 1950's, the problem of slum clearance was only being tackled by using more conventional construction types of buildings. During the growth years of the 1950's and 1960's, Birmingham (together with the rest of the nation) was obliged to rapidly increase the public housing stock.

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* excluding Sutton Coldfield. In 1974 local government reorganization the Birmingham District annexed Sutton Coldfield.

2.5.2 Multi-storey Dwelling Blocks in Birmingham

In the summer of 1951, the Birmingham Housing Committee announced that one-fifth of the dwellings in the 1952 programme would be multi-storey blocks of flats. Most of the blocks were in the central redevelopment areas, but also extended to the suburbs[31]. The first six blocks built were of only six storeys. From that time, the proportion of multi-storey blocks increased, and in 1963 the Housing Committee decided to build the first block using industrialised techniques in Birmingham. This was 9 storey block of the Bison wall frame (WF) construction type (see Appendix II). The main reasons behind this trend were politics, economics and social.

A database is developed and currently being inputted into a micro-computer system called PROXIMA*. These data were collected from the databases of Departments of City Engineers and City Architect (see Appendix II). From this database, it can be seen that Birmingham city now has 427 multi-storey blocks (until recently, there were 429, but two of the blocks were demolished in 1986), comprising many different types of construction. Of these blocks, 100 are industrialised buildings of large concrete panel (LP) construction. These LP blocks provided 5625 dwellings, which represent 25.5 per cent of the total number dwellings in multi-storey blocks. The other blocks are of conventional systems in brick, in-situ concrete, steel, and so on.

Within these blocks , there is a considerable range in height. The range starts from 6 storeys up to 20, for those blocks with conventional construction types, and

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* PROXIMA is a fully integrated, interactive micro-computer system developed to aid general administration and project management.

from 9 storeys up to 20, for those blocks with large panel construction types. There are also some 488 dwellings in two thirty-two storey blocks in a conventional type construction. Figure 2-1 illustrate the height ranges.

In 1953, the first five blocks were completed, and from that time, the number of the blocks completions continued to rise until the peak year of 1967, when 67 blocks were completed. In 1964, the first two industrialised housing blocks were erected.

After 1967, the number of housing blocks completions began to drop, and by the early 1970's, the relatively few days of producing such blocks in Birmingham were over. Figure 2-2 shows the number of block completions in Birmingham, of large panel system and conventional types, in each year from 1953 until 1975.

2.5.3 The Birmingham Boom Collapses

As shown in Figure 2-2, the number of multi-storey block completions began to drop from 67 blocks (32 LPS) in 1967, the peak year, to 22 blocks (8 LPS) in 1968, to 10 blocks (6 LPS) in 1969, and to only 2 LPS blocks in 1972. The final blocks in the development of Birmingham's multi-storey policy were two units of conventional construction type completed in 1975.

The reasons for this sudden fall in production are :

1. On political decision, for the most part related to economic and social conditions.
2. By 1967, the Housing Department was finding it difficult to let the multi-storey block dwellings.
3. The bad quality of the existing blocks had already revealed many defects.

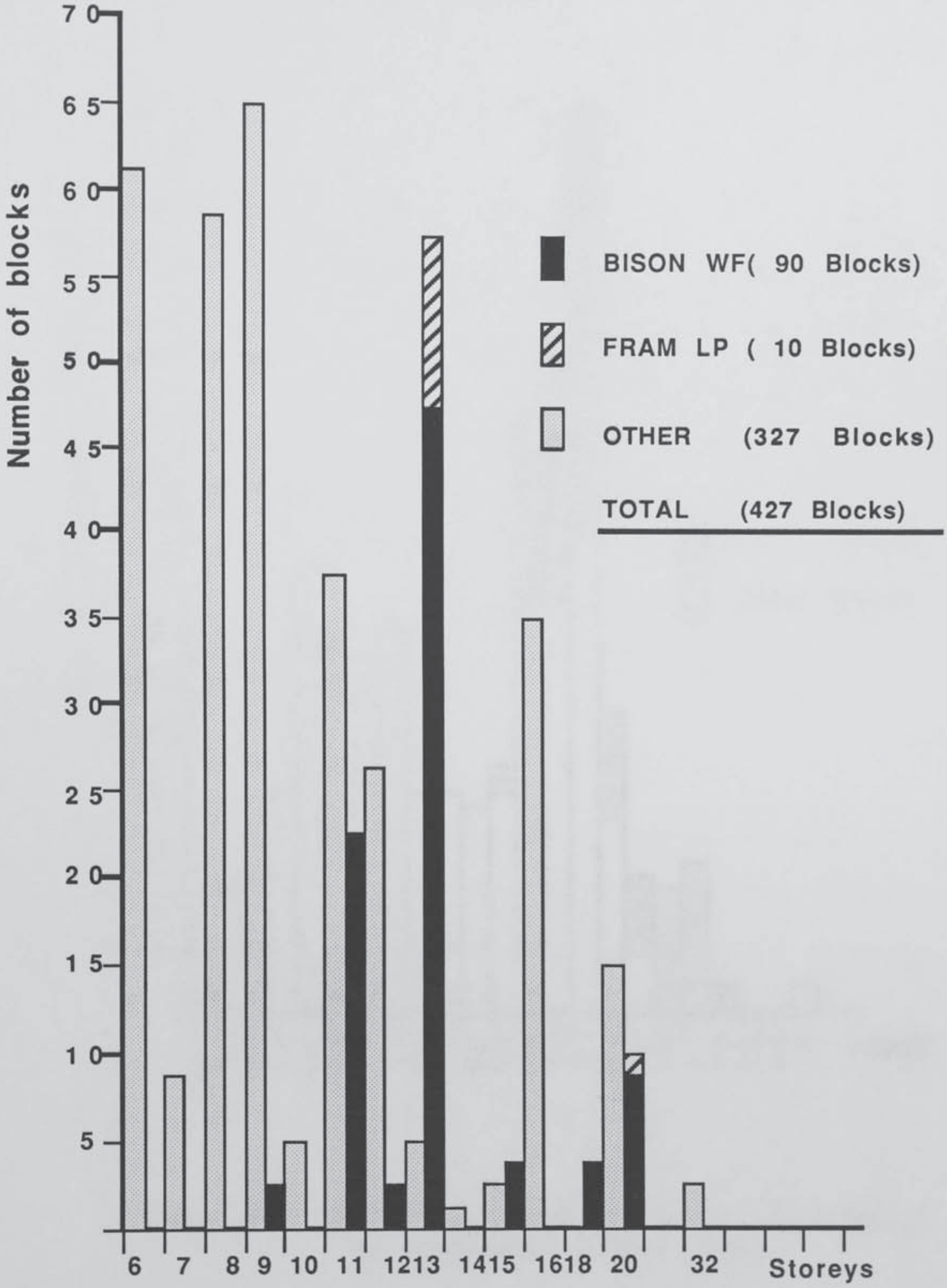

Figure 2-1: Height and Types of Blocks in Birmingham

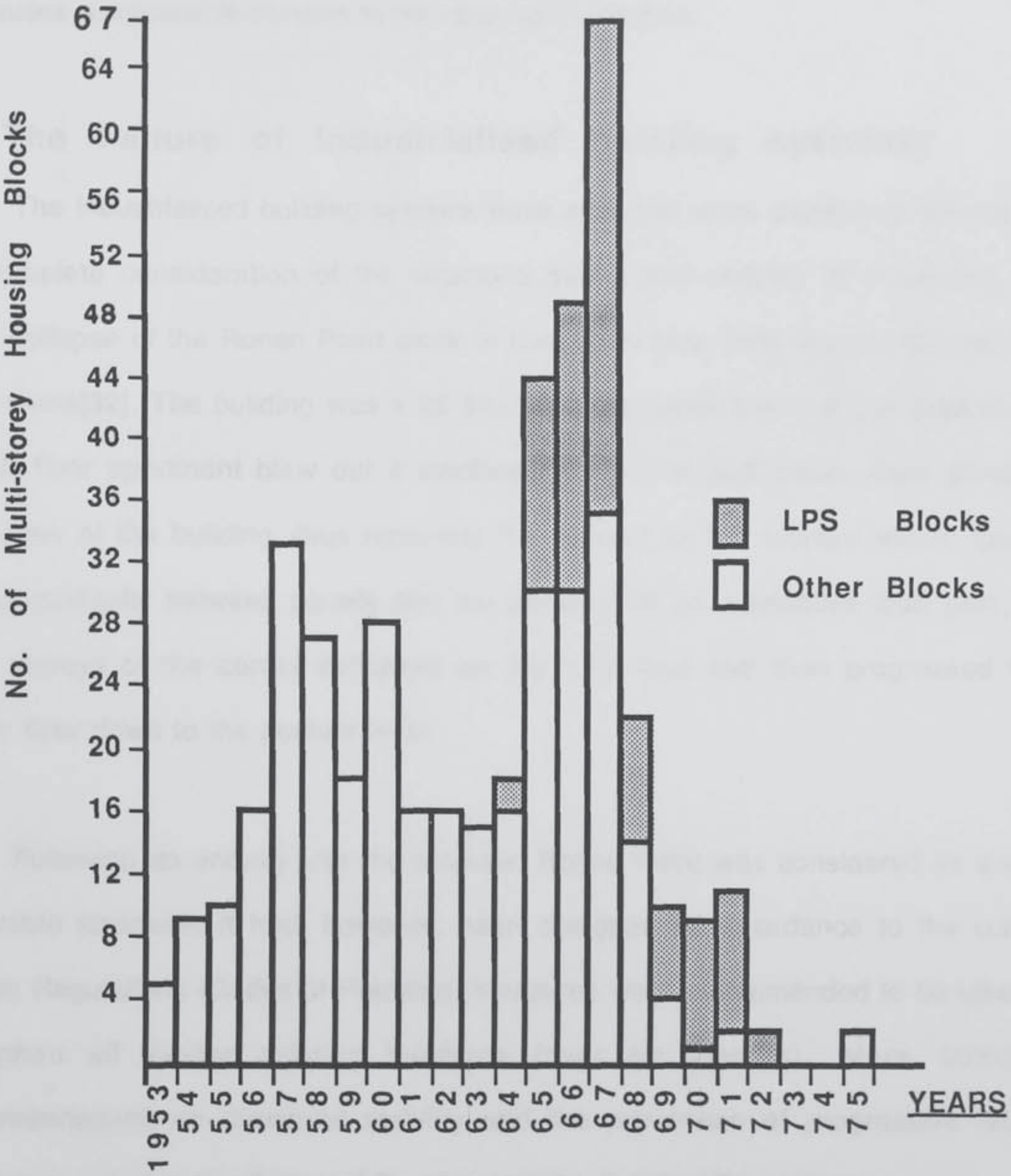

Figure 2-2: Multi-storey Housing Blocks Completions in Birmingham. (1953 - 1975)

In April 1969, the Housing Committee decided to concentrate on building low-rise houses and to no longer build multi-storey blocks. So, Birmingham had finally turned away from such blocks. However, the problems with these blocks still exist, and causes considerable concern to the Housing Committee.

2.6 The Failure of Industrialised building systems:

The Industrialised building systems have also had some disastrous failures due to incomplete consideration of the structural safety and stability of a building. The partial collapse of the Ronan Point block in London in May 1968 is probably the most famous one[32]. The building was a 22 storeys large panel block. A gas explosion in an 18th floor apartment blew out a loadbearing external wall panel (flank panel) at one corner of the building, thus removing the support for the storeys above. Due to lack of continuity between panels and the absence of an alternative load path, the upper storeys of the corner collapsed on the 18th floor and then progressed from floor to floor down to the podium level.

Following an enquiry into the disaster, Ronan Point was considered as a non-acceptable structure. It had, however, been designed in accordance to the current Building Regulations (Codes of Practice). Measures were recommended to be taken to strengthen all similar existing buildings (over six storeys). More stringent recommendations on structural stability and the prevention of progressive failure were incorporated in the Codes of Practice and the Building Regulations.

This disaster also greatly accelerated a trend that had started previously, and which had some social roots, i.e. move away from high-rise dwelling blocks to low-rise dwellings. As will be illustrated by the following Figure 2.3 and Table 2.1. Industrialised building systems suffered a severe set back from 1967 onward. If we can call this decline- failure, the major economic, technological and social causes of it can be out-lined as follows:

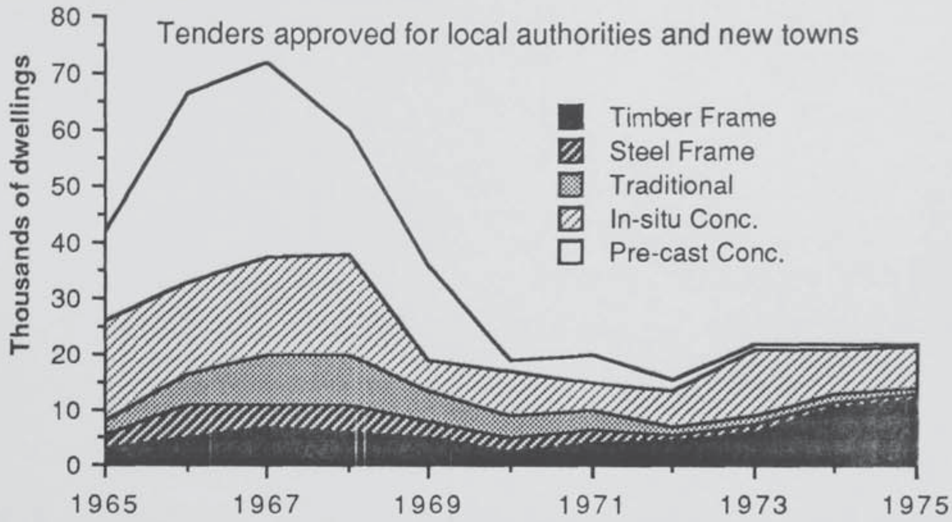

Fig. 2.3 Trend in industrialized building construction by type of system(19).

1. The housing programme at both central and local Government level had been erratic in Britain. This tendency become more marked following the economic depression and devalution in November 1967[33]. The national housing programme was cancelled and consequently a sharp reduction in public housing schemes took place in 1967[34].
2. The shortage of urban land for large housing schemes has been a major obstacle to achieving economic operations in Britain[33].
3. An increase in development of low-rise buildings, mainly because the social reaction against high-rise developments in the recent past. Most of these low-rise buildings are traditional systems.
4. After the inquiry into the Ronan Point explosion, many defects have become apparent in most of the industrialised building systems.

By now, experience however, has made it clear that the ideology of industrialised building systems in United Kingdom has generally failed, through not always and not in every sense of the word.

CHAPTER THREE

THE CURRENT TECHNIQUES OF BUILDING APPRAISAL
(A SELECTIVE LITERATURE REVIEW)

For the creation of a new inclusive appraisal technique to be used for large panel blocks, some of the current appraisal techniques for the housing and low-rise building are studied. When reviewing the current approaches, it soon becomes evident that they can be broadly classified as either physical appraisal techniques (such as those used for the estimation of maintenance requirements) or social appraisal techniques (such as those used by the Department of Environmental (DoE) for the study of the sociology of existing mass housing projects).

There have been few instances where these two approaches have been combined to give an integrated approach and certainly no cases where the emphasis has been on system built tower blocks. It is, therefore, necessary to study these two current individual approaches (with special reference to the LPS, the subject of this research) before any decision can be taken on how they can be altered so as to allow them to be applied together, in an integrated appraisal technique for system built multi-storey dwellings. Also, the literature review comprises another main area of importance. The recycling concept of the buildings components, as one alternative solution.

3.1 Physical Appraisal Techniques:

It is fitting to introduce this section with the words of Alan Twitchell, one of the world-pioneers of housing appraisal (measurement of housing quality) from Duncan paper[35], where he said:

> " In an era of precision chronometers, we in housing have been telling the time of day with an hour-glass. We need something at least as good as the dollar watch."
>
> A. A. Twitchell
>
> American Public Health Association, 1948.

There are a wide range of techniques for housing appraisal. To cover all the review methods is very hard task. Therefore a selective literature review has been done.

In the early 1970's, the University of Birmingham published an occasional paper entitled "Measuring Housing Quality "[35]. This paper was concerned essentially with the problems involved in attempting to measure, as objectively as possible, the physical quality of housing and its environment. It examined the various sources of information on housing conditions and characteristics which are generally available, and assessed the scope and limitations of each of these sources. It, also discussed the more radical possibilities among the various studies which had been conducted in Britain and abroad at that time.

Latterly, The Social Services Buildings Research Team (SSBRT)[36] at Oxford Polytechnic identified two broad types of appraisal of buildings which they termed "partial" (focussing on one or more discrete aspects of a building) and "inclusive" (focussing on all aspects of a building in a systematic way). Some of the partial approaches involve practising architects or engineers. While the remainder and all the inclusive approaches are the work of academics, including architects, engineers, sociologists ..etc. The present review also included two approaches by which the problem may be tackled. These can be classified under the following headings:

1. Theoretical approaches:

These are methods envisaged by professional engineers and/or university professors. They are purely theoretical studies comprising recommendations and guide lines which may be considered when formulating an appraisal technique. In this option, there appears to be six basic systems which are suggested as possible approaches:

a. Subjective descriptions appraisal;

b. Expert teams descriptions appraisal;

c. Technical appraisal;

d. Social and psychological appraisal;

e. Sociological studies; and

f. Environmental studies. (refer to reference [36] for more details).

2. Practical approaches:

These are generally compiled by large local authorities, universities, health authorities and/or similar public bodies. These are often architect or structural engineer orientated, using a checklist type format. Much unpublished appraisal work exists in practice, especially in local government architecture, structural and housing departments.

In 1978, Bishop[37], described a case study of a private housing development, based on the results and conclusions of works undertaken at the University of Bristol. A wide range of approaches for appraisal were used. In the conclusion he stated:

> "This paper has not attempted to argue why appraisal is important: it has taken it as self-evident that people would wish to gain some idea of how well a product costing a large amount of money actually performs, in order to avoid mistakes and benefit from successes in the future.".

Under the heading of physical appraisal techniques it is also necessary to include the studies carried out by structural engineers and other professionals whose published work gives guidelines for the carrying out of any structural surveys. The Institute of Structural Engineers (I. S. E.) have produced a set of guidelines under the title of " Appraisal of existing structures"[38] which covers in detail the structural appraisal of a building. Consideration is given initially to why an appraisal may be required, citing the main reasons as, defects in design or construction, deterioration with time or service, accidental damage, change of use and future safety or serviceability. For the appraisal itself, they go on to recommend detailed investigation of the construction materials by chemical, physical and visual analysis techniques and the structure's ability to resist fire, windloading, imposed loading etc., both by field tests and detailed calculations.

This detailed appraisal is intended to give an accurate account of the structural condition of a building, but is not intended to take into account environmental or social factors. Unfortunately this technique requires the employment of many experienced structural engineers over a long period of study and consequently very high fee cost must be anticipated for the appraisal of a single block.

Within the physical appraisal publications and pamphlets there are many references to checklists and measurement coding systems which have often been devised for specific, practical uses. With regards to this approach, the appraisal is carried out by means of a basic checklist comprising of a list of the main and sub-main elements of a building. With those elements being graded by the appraiser on a scale ranging from very good to very bad. Various different checklists have been developed for use on structures such as traditional houses[39,40] or more specifically, by Smith 1985, for use in hospitals[41]. In this paper a computer techniques was used to appraise the physical condition of every property within the case study estate in Bristol. The computer system consisted of two programmes providing a complete estate record. The first one provided the database. The second programme provided an analysis of the physical condition of the estate, by dividing the estate into 19 elements. Each element is given a standard of condition ranging from A to D. The annual and ten years maintenance programmes were produced in report form, from the collected data.

These measurement techniques are of the type which would conceivably be used by engineering departments (specifically the maintenance) within a local authority or private company for more information, assessment of repair and maintenance requirements and hence the planning of future works.

When using a measurement appraisal technique (such as checklists), it is useful to have a coding system which can be used for reference purposes. For instance, the Chartered Institute of Building (C.I.O.B.) Technical Information Service paper (T.I.S.P.) No. 47[42] gives a comprehensive coding system for use in maintenance appraisals. This system comprises a five figure code giving a unique identifier to any particular element of a building. The code then allows the computerisation of the system and subsequently better usage and monitoring of resources. This system was then tested on two studies and the results published in T.I.S.P. No. 53,[43].

A similar approach to that recommended by the I. S. E. is utilized by Bill Curtin and John Thelwell of W.G. Curtin and Partners, who have carried out many appraisals of high rise system-built structures over the last few years[44]. In their experience they have found that where details were "buildable", with good manufacture, erection and careful maintenance then the problems encountered were relatively minor. Conversely if these factors were not satisfied then the block will invariably be in a much poorer condition. Regarding the actual appraisal they recommend:

1. a detailed appraisal technique commencing with a "desk top study" of the original plans and specifications;
2. a visit should by made to the block to highlight problem areas, examine the exterior with binoculars and get a general "feel" for the future investigation;

3. a detailed survey of the block is completed looking at every thing from the external cladding (perhaps using window cleaner type gantries or "cherry pickers" up to 8 storeys) to the internal panel joints (by removal of access panels and stripping of finishes); and

4. an indepth structural study is carried out using information gathered from the previous work to assess the structures integrity, stability and safety (similar to the I.S.E. appraisal).

This should lead to the development of a "remedial measures statement", specification, preliminary costs and projected extended lifespan of the building[44].

This appraisal method again requires high levels of input from professional staff with accompanying high costs, although a cautionary note advises representatives of the client to be involved throughout the procedure, so that if a building needs to be demolished then all further, unnecessary studies are terminated.

Recently, a volume of the proceedings of a Symposium held at Bal Harbour, Florida on 17 Oct. 1983, sponsored by ASTM Committee E-6 on Performance of Building Construction was published[45]. This volume contains thirteen papers about the preservation and rehabilitation of buildings. These papers are in two groups: Theme A, to improve overall building performance and diagnostics, and Theme B, for historical buildings and building materials. This was the first symposium leading to standard development for measuring overall functional performance. The symposium was organized for two main purposes:

1. to elicit new methods and data; and
2. to provide a starting point for standards development work on the two themes.

Also, The International Council of Building Research Studies and Documentation (CIB) published in their journal articles under special feature called

" Building Pathology", which means the study of defects in the buildings[46]. One of them is on the "Dutch Housing Condition Survey" from the Bouwcentrum in Rotterdam[47]. It explained how research there has helped to strike a balance between survey cost and the information required, by combining overall enquiries with detailed investigations of buildings. By multiple linear regression, "estimators" are derived which convert the overall assessment into "prediction" of the global data sought.

The investigation is carried out by a building expert who assesses the quality of the dwelling by examining about 50 building components. Each of these components is broken down into a number of types of materials. For each of these materials the amount of material to be replaced can be indicated. An estimate of the cost of repair of the entire element is also given. Beside this, possible defects of elements can be recorded and the seriousness of the defects indicated. The appraisal of the dwelling elements is based on three criteria:

1. condition of component: six-point scale;
2. cost of repair: ten-point scale; and
3. number of defects; 0 to 6 scale.

The conclusion was, that the proposed method has proved to offer a relatively cheap and quick way to obtain reliable data on the condition of large housing stocks.

The foregoing are a selective literature review about the physical appraisal in general. The next section will deal with works associated with the large concrete panel blocks.

3.1.1 Physical Appraisal of Large Panel Blocks:

The first study and appraisal of large concrete panel blocks in Britain was conducted in 1968 [48]. When the report of the inquiry into the collapse of the flats at Ronan Point was presented to the Minister of Housing and Local Government of the day. This report studied the reasons for the collapse, and dealt with lessons that might be learned from this disaster. Finally, the report set out in summary form, the conclusions and recommendations. The main points of these recommendations were that: Ronan Point should strengthened, in particular by making the joints stronger and providing more continuity, so that local damage to the load-bearing walls from whatever cause would not lead to progressive collapse; and so that the building is capable of safety with standing the maximum wind load. In addition to that, there were interim recommendations about gas disconnection.

These recommendations were extended to all existing blocks, and building regulations and Codes of practice. Following this the Ministry of Housing and Local Government issued advice to Local Authorities in Circulars 62/68 and 71/68[49].

After the discovery of small gaps at junctions between non-loadbearing bearing cladding panels of the facade and the floor panels in Ronan Point, other reports were conducted on the block, by the Building Design Partnership (BDP) [50], Thomas Akroyd [51] (both are firms of consultants) and Mr. Sam Webb [52]. They summarised the findings of investigations to date.

In 1986, BRE [53], published a report, which comprises the results of an examination of the above consultant's reports in the light of discussions, calculations, design recommendations, research information and documentary evidence on Ronan Point and other Taylor Woodrow-Anglian (TWA) buildings. In the main conclusions and recommendations, there were four possibilities for remedial measures necessary to maintain Ronan Point in a satisfactory structural condition :

1. repair or reconstruction of flank wall joints (H2) in the lower eight storeys;
2. strengthen the joints in highly stressed locations;

3. provide comprehensive strengthening by building an additional load bearing system; and

4. remove the top eight storeys from the building.

The implications for the structural appraisal and remedial measures to the other TWA buildings were also discussed.

It was finally decided that Ronan Point tower block should be demolished panel by panel, as dynamite would be too dangerous. Gradual demolition (dismantling) and on-the-spot tests have shown that some load-bearing wall joints in the block are packed with soft materials instead of drypack mortar[54]. Three fundamental failings lay behind the problems of such blocks: poor detailing, bad workmanship and inadequate supervision.

In Glasgow, the water penetration of large panel system blocks (Reema system) had be corrected by over-cladding with aluminium sheeting packed with 25 mm. polystyrene core. The storage system heating is used and installed with the rent to maintain even heat. These programmes proved effective in removing condensation and providing comfortable and affordable heating. But, it is costly and limited to specific factors. The main other factors are excluded such as vandalism, insecurity and so on[55].

The most advanced BRE publication is a report on " the structural adequacy and durability of large panel system (LPS) dwellings. This report comprises three documents, namely:

A). Part 1: " Investigation of Construction"[56]:

This part describes the investigations of structural adequacy and durability of large panel system(LPS) dwellings. It gives a view of the range and variety of physical conditions which may be encountered in large panel construction according to the results of BRE inspections and the summaries of investigations made by building owners and their consultants. The finding were considered under four headings:

1. Reinforcement in joints;
2. Reinforcement in panels;
3. Precast concrete; and
4. In-situ concrete.

followed by some points specific to parapets and balconies.

In the main conclusions of this part, there were some interesting points noted:

a. The BRE has found no LPS building showing sign of structural distress sufficient to give concern for the safety of people.

b. Following the collapse of a part of Ronan Point in 1968, a programme of structural appraisal and strengthening of LPS buildings was undertaken. Since then no major structural failure in such buildings in the U.K. has been reported.

c. A number of variations from the original design and specification have been found in some of these blocks.

d. Cracking and spalling of concrete arising from corrosion of reinforcement in the external envelope.

e. Corrosion of reinforcement in wall or floor panels or in the connections between them is unlikely to present a risk to the stability of LPS buildings unless it becomes substantial and widespread.

The investigation into the Bison system, in this part of the report, consisted of inspection of two blocks on two sites. The first one was 3-storeys block built in 1960's. The second was 6-storey block built in 1967. Both being demolished as a part of a replanning programme. The discussion was limited to specific points, such as: component/joint condition, concrete cover, depth of carbonation, % chloride ion by weight of cement, % of cement and condition of steel. The general findings and conclusions are giving in the main text of the report, which is based on detailed information given in Appendix A of the report, on the output from Bison and other large panel systems inspections;

B). Part 2: " Guidance on appraisal"[57]

This part gives general guidance on the appraisal of structural adequacy and durability of LPS dwellings. It gives guidance for the engineer to interpret and apply its recommendations to the particular circumstances of the building being appraised on the basis of his engineering judgement. It is quite similar to the ISE approaches[38]; and

C). A summary of the report in the form of a BRE information paper[58].

Other BRE publications on large panel system (LPS) dwellings deal with the weatherproof joints for identification and typical defects[59], remedial measures[60], investigation and diagnosis of failures[61], flat roofs, balconies and deck access ways[62]. In addition to the other publications which deal with appraisal of passive fire precautions in large panel system dwellings[63], and a report on overcladding external walls of the system[64]. These publications are some of a series being prepared as part of BRE's programme of investigation to assist local authorities and their consultants in management, appraisal, maintenance and repair of large panel system dwellings. Research related to these investigations is continuing particularly in relation to accidental loads such as those which may arise from explosions. Therefore, further guidance may well become available for assessing the sensitivity of LPS dwellings to accidental loading during the writing up of this thesis.

In the most recent paper[65], a brief comments on the benefits and shortcomings of the physical test methods available to the engineer involved in a structural assessment of the large panel building condition; such as visual inspection, non-destructive testing, chemical and mechanical test methods and loading tests.

3.2 Social Appraisal:

Multi-storey dwelling blocks in one study or another have been directly linked to psychological and social factors, such as people's satisfaction, health, attitudes and behaviour. The majority of published works had been carried out in the period between the mid 1950's and the late 1970's. During this period many of the more serious slum areas of Britain had been, or were in the process of being cleared. There was evidence of dissatisfaction amongst the people who had been re-housed in their new dwellings of large, high density estates at that time. This dissatisfaction was not with the condition of the dwelling but was now aimed at the social climate in which the dwelling was situated. In response to this new emphasis on dwelling "quality" there were a number of social studies carried out.

In order to determine peoples response to high-rise living (multi-storey dwelling blocks) and some related social factors, it is necessary to consider the following important factors separately:

3.2.1. Satisfaction :

One of the earliest studies of satisfaction in multi-storey dwelling blocks was carried out by the London County Council, in 1954[66], when only five out of 68 families living on the sixth floor or higher, said that they like to move to a lower level.

In 1960, John Macey said (when he was Housing Manager in the City of Birmingham - a city that was then pioneering multi-storey dwellings) :

> " There is little doubt that about 80 per cent of our customers would prefer a house to a flat ... I would, as Housing Manager, recommend that the use of high flats should be restricted."[67]

Another survey carried out by the Greater London Council (GLC) in 1968[68], found that 77 per cent expressed a positive liking for their accommodation and about 20 per cent expressed a positive dislike. Over 30 per cent would have chosen the ground to second floors if they had been given a free choice of floor in a 24 storeys block. Another 15 per cent the third to fifth floors, and over 20 per cent the twenty-first to twenty-third floors. Nearly half the tenants would had chosen the lowest or highest floors. " from the reasons for the choice it was clear that both these floors had some of the attributes of a house. The lowest floors were popular because of nearness to the ground, convenience for children and lack of dependence on lifts, and the top floors for quietness and privacy. The middle floors were less popular. Possibly people feel more enclosed with other families above, below and around them. Thus the taller a block the larger the number of dissatisfied tenants there are likely to be."

Although the results of the 1960's studies showed a majority of those living in multi-storey blocks were content with high-rise living, the numbers dissatisfied were significant, e. g. one in five to one in six. However, although most residents did not express dissatisfaction with their new flats, the evidence was that the great majority would nevertheless prefer a house if they had the choice. The Department of the Environment (DoE) studies found that more than 71 per cent of housewives in multi-storey dwellings would have preferred a house.[69,70]

In the rest of Europe, the attitude to high-rise living is the same as in Britain. For instance, in Scandinavia during the 1960's, a study in Stockholm, found in response to the question: " How do you feel now about living off the ground?", that 68 per cent of respondents were happy and 16 per cent unhappy and concluded that housewives living in high blocks were not more dissatisfied than those in lower blocks or houses. The study also found that 37 per cent of tenants preferred a flat in a block no more than four storeys high and 17 per cent wanted to be a block over nine storeys high, most of these preferring to live in the top-most storeys[71].

In the second half of the decade (1960's), Pearl Jephcott and Hilary Robinson investigated new multi-storey dwelling blocks in Glasgow and published their results as a book entitled "Homes in High Flats"(1971)[72]. This interesting study was mainly based on nearly 1,000 interviews in 168 multi-storey blocks rising at least six storeys and served by lifts. Spontaneous comments made by the tenants were classified as shown in the following table:

Aspect assessed	Number of tenants expressing		Dislike percentage
	liking	dislike	
Dwelling	838	493	37
Block	485	701	59
Estate	529	492	48
Total comments	1852	1686	48 %

Table 3-1 Residents' comments on their multi-storey dwelling in Glasgow[72]

As shown in Table 3-1, the balance of 'likes' was greatest for the dwelling itself, as subsequently found elsewhere, but 'dislikes' predominated in relation to the block as a whole. These were, first and foremost, the lifts, followed by loneliness and isolation, the entrances, vandalism, inadequate laundry provision, noise, poor maintenance, and refuse disposal problems. Graffiti was not mentioned. Some blocks were clearly better than others; some people spoke appreciatively of good sound-proofing and noise reduction. With respect to the estate as a whole, 'likes' and 'dislikes' were more or less evenly balanced. However, two-thirds of the reasons for liking the estate were not based on the estate's own characteristics, but of their location near to good transport, shops and other facilities. Taken as a whole, the 'likes' slightly outweighed the 'dislikes'.

They found, also, that about 90 per cent of the sample said, that on the whole they were satisfied with living there. They suggested that people living below the tenth floor can just about manage the stairs in an emergency, can see things going on at ground level and can communicate verbally with people on the ground.

Whereas some of the Department of the Environment's own research indicates a fairly high level of satisfaction on high-rise estates, although over 40 per cent of respondents said they would prefer a house, and of those who would like to move 60 percent said they would like a local authority house[73]. It is apparent from the same review, that certain groups are more suited to multi-storey living than others. In particular, families with children under five years old are frequently the least satisfied. Those with older children, slightly more satisfied. Adult families and elderly the most satisfied. Table 3-2 illustrates this point well.

Also, little relationship was discovered between satisfaction and block construction type (i.e. traditional, industrialised tower block, or slab block, etc.) which is, in fact, that this relationship plays a negligible part in people's overall satisfaction compared to the other features of the block.

Households living off the ground	% Unhappy	Number
Households with all children under 5	39	49
Households with some children under 5 and some over 5	31	134
Households with all children over 5	14	165
Adult households	12	321
Elderly households	10	205
	Total	874

Table 3-2 The different households reaction various multi-storey building form at the end of 1960's [73]

Two other studies carried out in the late 1960's by the Department of Housing and Local Government and were aimed specifically at high-rise, high density dwellings can be found in their design bulletins numbers 15[74] and 21[70]. The approaches typified in these early surveys were different for each case using only a basic outline with detailed questions being re-written for each new survey. Eventually the approach was rationalised into one inclusive approach by the Department of the Environment (DoE) in their Housing Appraisal Kit (HAK)[75]. This is available in the form of a complete project kit comprising of a long questionnaire for interviewing households. Together with instructions on how to set up the process, analyse the information and interpret the results. The analytical stage can be carried out using an associated computer package which is an optional extra to the basic kit.

In the beginning of 1970's, Pearl Jephcott, made a study of some 60 housewives living in multi-storey dwellings in Birmingham, and found that nearly all of them had tried to move out at some stage, and many had made repeated efforts to do so. She also found that there was no desire to move from the higher floor to a lower floor level, unless they could be on the ground[76]. For some, getting out was an obsession, and their ideal was often a house on the same estate. This suggests that it was the high-rise dwelling itself which they disliked rather than the estate.

In the beginning of 1980's, a large and intensive research investigation was carried out by the Land Research Unit at King's College in London. The findings were published as a book entitled "Utopia on Trial"(1985)[11]. The book was written as an analogy with a trial, which opened with an outline of the salient events leading up to it . This was followed by a discussion of the nature of the evidence and account of the design variables. Fifteen suspect design variables in blocks which affect the behaviour of at least some residents, especially children, and also other people using the building were identified (as shown in Table 3-3). After that, dissenters have a chance to cross-examine and present alternative views of their own. The next two chapters considered preventive measures and corrective measures respectively. A comparison of different locations was made to see whether there are any local characteristics that seem to be responsible. The study covered 4,099 houses and 4,172 flats and converted dwellings, with additional information from a variety of other British and foreign sources.

The fifteen suspect variables are listed in table 3-3. Four are related to characteristics of the block or the dwelling, four are related to circulation within the block, three were related to aspects of the entrances and the remaining four to features of the grounds. 74 residents interviewed in one block. The interviewees were asked to say what they thought about their blocks or estates. Were they in favour of the fifteen variables or against them. Table 3-3 includes first comments only; repetitions at the prompt stage are excluded? It is of interest that four times as many comments were critical of the design variables as in favour of them. Each of these variables was discussed in details in the references[11].

Design variables	Spontaneous comments For	Spontaneous comments Against	Prompted comments For	Prompted comments Against	Total
Size variables:					
1. Dwellings per block	2	31	3	11	47
2. Dwellings per entrance	-	3	-	12	15
3. Storeys per block	10	45	4	5	64
4. Storeys per dwelling	-	-	nm	nm	-
Circulation variables:					
5. Overhead walkways	1	30	-	6	37
6. Interconnecting exits	-	2	3	13	18
7. Vertical routes	-	2	-	2	4
8. Corridor type	5	35	2	10	52
Entrance characteristics:					
9. Enterance position	3	-	2	-	5
10. Entrance type	-	-	nm	nm	-
11. Stilts and garages	6	22	nm	nm	28
Features of the grounds:					
12. Spatial organisation	15	54	1	6	76
13. Blocks in the site	-	-	-	-	-
14. Access points	-	10	nm	nm	10
15. Play areas.	25	24	nm	nm	49
Total	67	258	15	65	405

nm: Not mentioned as a prompt by the interviewers.

Table 3-3 Suspected design variables and interviewee's comments[11]

Prevention would seem to lie in a decision to built no more flats and concentrate on houses instead. The various test measures (litter, graffiti, vandal damage, children in care, urine and faecal pollution) show that inter-war houses consistently perform better than those either the pre-1914 or post-1945 vintage. Corrective measures involve the rehabilitation of existing multi-storey dwelling blocks. A disadvantagement score for blocks was devised to count how many of these 15 design factors gave rise to dissatisfaction.

The correlation analysis used in the study, strongly supports the evidence of the trend lines in showing that the association of poor design with social malaise is a genuine phenomena, far more consistently than could be expected by chance.

In April 1986, research was carried out by the Housing Department in the City of Birmingham[77] about the validity and assessing demand for Vertical Warden Schemes (VWS). Vertical Warden Schemes (VWS) are multi-storey dwelling blocks converted to provide sheltered housing, mainly for elderly people. The conversion works consist of :

1. Carpeting, decorating and lighting improvements in communal areas;
2. Installation of alarm system; and
3. Creation of a common room within the block.

The system cost about £1,500 a flat (in 1984/85 prices). A Warden is appointed once the alarm system is commissioned, and the Warden's duties are the same as in all sheltered housing: visiting, encouraging communal activities and responding to emergencies.

In general, the response of tenants to conversion is positive, and they are satisfied with their new warden system homes. Most residents perceived a reduction of problems within the blocks after conversion to Warden service, with the important exception of repairs. This help in reducing disturbance from neighbours, security has increased and problems with children or young people getting into the block and vandalism has been significantly reduced. The social fabric of the blocks was also perceived to have improved.

But, the most interesting result mentioned in this study is that most of the City studies indicated that houses or bungalows were the most popular type of dwelling requested by the people, followed by low-rise flats with high-rise dwelling representing only 8.7 % of requests expressed, as shown in table 3-4.

The majority of preferences seem to be based on a desire for dwellings of a particular type rather than presence of a Warden. Eighty eight percent (7) of people who request a VWS also requested a standard high-rise dwelling. The implication is that VWS (because

Property types	Requests	Percentages(%)	
1. Warden Service Bungalow	56	28.4	54.7
2. Bungalow	52	26.3	
3. Warden Service Low-rise flat	38	19.3	35.5
4. Low-rise flat	32	16.2	
5. Vertical Warden Scheme	8	4.1	8.7
6. High-rise flat	9	4.6	
7. House	2	1.0	1.0
TOTAL	197	100 %	

Table 3-4 Property Type Requested [77].

they are high-rise properties) might be acceptable, but are unlikely to be specifically requested and are, therefore, not seen by the vast majority as specially desirable[77].

In the conclusion: if we look through the output of some references [11,72, 73, 76 and 77], it seems that the level of satisfaction and the attitude to multi-storey dwelling blocks is decreasing with time.

3.2.2. Crowding*:

The main reason underlying the concept of multi-storey dwelling blocks was the building density (number of person or dwelling units per structure). The significance of building density would seem to be in the separation of dwelling holders from one other by walls, floors and ceilings This population density may lead to the crowding*.

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* simple definition of crowding as some form of social overload.

Several reviews do exist, explaining the evidence of the effect of crowding on human population[78,79]. In general, psychological studies have yielded mixed results. Some have found states to be associated with high social density[80], or that even the anticipation of being crowded elicits a negative mood[81]. However, these studies did not show a very strong personal reaction to increased density.

On the subject of social perception, the findings again reflect a mild negative social reaction. Much of the research on the density effect on social reaction centred around the study of attraction and withdrawal[82]. For example, it had been demonstrated that male subjects experience more negative moods in high density conditions, for female subjects, there was a more positive reaction[70].

Other literature indicates that the effect of crowding is manifested in physiological responses where suitable physiological measures are employed, it is significant that each is a measure of stressful reactions[83]. Perhaps the most noticeable feature of crowding residential environments is the vertical rather than the horizontal stacking of dwelling units. It has been argued that the physical design of these, may relate directly to urban pathology[82]. Within multi-storey dwelling blocks, there is very little correlation between satisfaction and crowding. It seems that the overall estate density has little bearing on resident's opinions.

3.2.3 Health:

It is generally believed that families living in multi-storey blocks are exposed to certain socio-medical hazard. For instance, the residents of multi-storey flats were show to be three times more likely to suffer respiratory illness. In social structure interviewing, one must take account of psychological responses and adapt them in order to establish correlation between the accommodation type, density and health. One must surely look to the nature of disease, the method of transmission and all other related factors before drawing any conclusion.

Social scientists have long been interested in the relationship of dwellings to people's health. In the early 1960's, most studies failed to show any benefit to mental health either from new dwellings, the effect of the move itself or moving to better old housing[84,85].

Fanning[86], in 1967, found that morbidity of those families who lived in flats was 57 per cent greater than those who lived in houses. The greatest differences were seen in the incidence of respiratory infections in young women and children and of psychoneurotic disorder in women. In other words, Fanning found that different physical ailments and psychological strains (psychosomatic symptoms) not only varied with building design (single, detached houses, and multi-storey dwelling blocks), but that strain among flat dwellers varied directly with the floor level on which their dwelling units were located. He observed that subjects who suffered from strain and inhabited the upper stories had a tendency to report feeling lonely, and concluded that isolation and loneliness intervenes between high-rise living and psychological strain.

Extensive research on high density blocks in Hong Kong provides additional support for the notion that floor level is associated with psychological strain. Of the several dwelling characteristics examined by Mitchell, floor level was the only direct correlate of "emotional strain"[87]. Like Fanning, Mitchell suggested that the inhabitants of upper stories are more confined to their dwelling units than other residents of the lower floors. However, he hypothesized, that confinement first results in loneliness and then strain.

In the1970's, Moore examined the personality and mental health of flat dwellers. The proportion of persons with neurotic personalities in flats was not significantly greater than that in houses. Flat dwelling, but not house dwelling, caused sufficient stress for neurotic personality, among them, to increase clinical psychiatric illness[88]. In 1977, Gillis established floor level as a positive predictor of strain among women. The relationship resisted attempts to attenuate them by controlling for household composition variables, socio-economic status selected demographic characteristics and three plausible intervening factors, confinement, social isolation and problems with child supervision[82].

3.2.4. Vandalism and Crime :

The vandalism and crime which many large urban building developments suffer have led to an increasing search for means of controlling vandalism and crime. Limiting communication may reduce informal systems of control by a breakdown in sense of responsibility for what happens outside one's immediate dwelling unit. Such a breakdown can lead to increased vandalism, crime and a decline of present safety. Oscar Newman's notion of "defensible space*" suggests that dwelling units design influences people's feeling of responsibility for public area. This, in turn, effects the tendency towards vandalism and crime in an area[89].

When Yancy analyzed the breakdown of the Pruitt-Igoe project, he concluded that the physical design of the project had exerted an "atomizing" effect on the informal social networks. At the core of the problem, he argued, was a lack of adequate defensible space[90]. Other studies argued similarly that planners can reduce urban vandalism and crime by designing physical settings that foster optimal social use and

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* Defensible Space: Physical space that is characterized by a high level of social responsibility and personal safely.

encourage residents to personalise the environment and assume responsibility for it[10,91].

The common theme about multi-storey dwellings is that: this form of dwelling is anti-social and a precursor to crime, vandalism and other symptoms of urban disfunction[92]. Taken together, they represent one of the popular myths of high-rise living. Oscar Newman forewarned Canadians to stop housing families in multi-storey building, as he saw them as a breeding ground for urban problems[93].

In the U.K., DoE studies have found that on average 28 per cent of people residing in all kinds of blocks said that damage to the estate is a problem. Vandalism is usually attributed to children, with the main targets being landscaped areas, entrance lobbies, stairways, lights, windows and lifts. It is worth noting that acts of wilful destruction rarely occur to those parts of the property that are occupied by residents. The damage being mainly confined to communal areas. With regard to crime, some people live in fear of vulnerable communal areas in the block, and people complain of vandalism in them. Birmingham City Council has debated whether the police should patrol the decks of multi-storey dwellings in view of the amount of crime at these unguarded and highly vulnerable levels. However, this is already done on deck-access schemes in London with no visible effect on the rate of damage[68].

3.2.5. The Elderly :

The studies of the elderly have indicated that they are more likely to be satisfied when they are more concentrated in high density developments, which afford them opportunities for socialising, rather than in situations where they are socially isolated. Some studies indicate increasing satisfaction with flat life with age. The DoE research shows that of those who expressed a desire to move from their current estate more of the elderly would have preferred a flat than of any other groups; also only 10 per cent expressed unhappiness with living off the ground, a lower proportion than in any other group[73].

An earlier study of dwellings for old people found that 75 per cent thought the best sort of dwelling was a bungalow[94]. Loneliness has often been pinpointed as a great problem for the old in high-rise dwellings. The main advantages for the elderly in living high up have been thought to be the view and the quiet environment. The disadvantages that the peace may turn to solitude and a sense of isolation, the difficulties of summoning help in an emergency, and when lifts break down.

In 1979, approval was given to the Vertical Warden Schemes (VWS) for elderly people in the City of Birmingham. 56 blocks have been design for conversion creating 2,387 converted dwellings. 41 blocks are currently in operation[77] (see section 3.2.1). The scheme gives good results but with limitations. This is because most elderly people prefer other types of buildings.

3.2.6. Families with children :

All the previous studies clearly indicate that families with small children living in multi-storey dwelling blocks experience severe problems. DoE research has shown that the general satisfaction of this group is closely related to the age of the children and to the play problems the mothers experience. In high density development, where most accommodation is in multi-storey blocks, as many as 87 per cent of families with children have considered facilities for children's play to be unsatisfactory. The families have more social contact when at ground level compared with those living off the ground. According to the situation of the children themselves, DoE research has demonstrated that children who live above the first floor play out less than those with ground or first floor access to their dwellings[95].

Gittus's study found that 50 per cent of mothers in the various multi-storey dwelling blocks mentioned the lack of play opportunities, the strain of having to watch their children all the time and the bad effects on the children of having to be indoors. The children from multi-storey dwellings play outside less than those from low-rise dwellings and much less than those living in houses. They also played nearer the entrance, and play alone more than with others[96].

Similar problems were mentioned in Jephcott's study in Birmingham. She suggested that where children must continue to live in flats, special provisions should be made for mother and baby groups for families with children under 3 years old, supervised play schemes for older children and a "home teacher" scheme where some mothers visit others and break down the isolation by talking to the mothers and playing with children[76].

In 1976, the Home Office found child density to be the one socio-economic variable that is correlated with vandalism more strongly than block design[11]. This leads to a gradually reducing of the child density in multi-storey dwelling blocks, partly because some resident children have grown into adults and partly because families with children are not introduced into dwellings becoming vacant above the fourth floor.

3.2.7. Conclusion from Previous Social Studies:

Below a brief conclusion summary of the features and impressions of the literature is presented :

1. There are many factors tending to influence general level of satisfaction in multi-storey dwelling blocks.

2. There is a slight correlation between increased density and psychological and social feelings.

3. The dwellers of multi-storey blocks had a significantly higher incidence of several diseases than those in houses, and they also tended to visit or call the doctor more frequently.

4. Multi-storey dwelling blocks necessitate some communal areas (lifts, entrance halls, staircases, play ground, etc..), these have to be available to all users and are vulnerable to vandalism and crime.

5. It seems that high dwellings have advantages and disadvantages for old people, and it is partly a matter of personal preference. It may be that dwellings a few floors high with lift access would avoid the disadvantage of ground floor life and present less extreme problems of isolation compared to higher flats.

6. Multi-storey dwelling blocks with a high proportion of elderly tenants must be provided with community facilities (such as, commen room, a small library, Warden supervision) to help them counteract loneliness.

7. Families with small children have preference for low-rise or houses with gardens. Multi-storey blocks are an unsuitable form of accommodation for them.

8. In blocks with good security systems and an entryphone service the level of satisfaction of elderly and adult residents is especially high, indicating that if the building can be kept quiet, clean and the lift service is reliable, the blocks can provide suitable dwellings for many.

9. The construction type of the blocks is not significant to occupants perception of satisfaction. Therefore, the new social appraisal technique can be used with multi-storey dwelling blocks in general, rather than the large panel system only.

However, the success or failure of multi-storey dwelling blocks is largely determined by the type of household living in them. They affect different groups of people differently according to their age, sex and income. It seems that such dwellings are suitable only for certain types of people at certain stages of their lives.

When considering the above two main areas (i.e. Physical and Social) of study, it is noticeable that they have been primarily considered separately with no interface between them. One type of appraisal which did attempt to integrate some aspects of the physical and social techniques was formulated by the American Public Health Association (A.P.H.A.)[35]. This study was designed to assess the adequacy of the services within a dwelling in America during the early 1960's. It was based on a checklist type format with each aspect regarding the provision of services included on the list. Each separate listing of these aspects was then attributed a number, which gave it a significance weighting (eg. heating may be attributed 30 marks whereas provision of telephones may only have 10 marks). This marking system was then used as the basis for grading the dwelling whereby a defect would reduce the score allocated to a particular element (eg. a serviceable heating system, satisfying the demands placed on it would score 30; a poor quality system with low heatoutput and in need of repair would perhaps score 20; a totally unusable system, beyond repair would score 0). The total score for the dwelling was then combined with its newest neighbours to highlight problem blocks, estates or regions.

This system was subsequently introduced to Britain in a modified format by the Scottish Development Department in the form of their Housing Defects Index which also took into account the structure of the dwelling as well as the services within it[35].

In U. K., since 1967, a series of reports contain results of various housing and housing condition surveys carried out by or for the Department of the Environment DoE (or the former Ministry of Housing and Local Government). Some of these surveys (5-year cycle) were carried out in three stages:

1. a physical survey of the housing[97,98]:

   The physical and environmental conditions of the housing stock were measured by three main indicators: lack of amenities, unfitness and the incidence of disrepair;

2. a social survey (as questionnaire):

   This survey was to provide information about the characteristics, circumstances and resources of the occupants of housings in poor condition; and

3. a local authority postal survey:

   Local authorities were asked by means of a postal questionnaire to record whether the sampled housings in their area had been the subject of any completed, current or proposed action in pursuance of their housing duties.

Data from the three stages brought together and the results from the complete survey were published in a separate reports [99,100]. The surveys were based on samples of about 9,000 housings in 215 local authorities.

3.3 The Recycling Concept :

Now, at a time of economic recession when a slow-down in the pace of building has developed. It is opportune to examine the attitude towards the re-use (recycling) of building materials or components. This recycling concept is a particular form of redevelopment. The broad definition of recycling fall into one or other of the following categories[101]:

1. Recycling in which the use does not change and there is no major change of the fabric.
2. Recycling in which there is change in use, but no major change in fabric.
3. Recycling in which periodic additions are made to cater for changed needs.
4. Recycling in which the building shell is retained and the building interior changed.
5. Recycling in which the facades only are retained to form an element in a new building.
6. Recycling in which the building is incorporated as an element in a larger construction or in a new sequence of buildings.
7. Recycling in which elements of the building are reused decoratively or as sculptural elements in the spaces or parks related to buildings.

The recycling definition, which is used in this study, mainly will be according to (6) and (7) definitions.

Industrial buildings are the obvious starting point for the recycling study and the idea of demountability. This is through the conception of merely "dismantling the building components and later simply installing them, or installing the components and later simply removing them". This concept of recycling is relatively new, and as a consequence, there is very little published literature on this subject. Most of them dealt with the recycling of low-rise buildings. A solution of this type for the buildings has not yet been adopted as a feasible alternative in the United Kingdom.

Recently, an International Symposium on "Demountable Concrete Structures: A challenge for precast concrete" was held at Rotterdam, Netherlands [102]. It was managed by committee D7 from CUR-VB (Netherlands Committee for Research, Codes and Specification for Concrete). The committee decided to start its research with building assembled from prefabricated (pre-cast) components. Floors were chosen as the first category of members to be investigated. This is because they account for the largest quantity of concrete used, their large size and floors are the most labour. The desire is to be able to dismantle or demount the components in a simple manner. The joints have been the subject of separate research committee.

For the recycling of prefabricated building, Hasslinger, 1985 [103], reported in his paper : the general principle, economic questions and experience of dismantling three medium-sized precast reinforced concrete office buildings in Vienna, and re-erected in another place.

The tasks were broken down as follows:

1. planning and construction;
2. dismantling;
3. transport (various distance); and
4. reassembly, including replacement of equipment and fittings damaged or destroyed during dismantling.

The economic sense of this reconstruction method described in the paper was clear. Where the cost of reassembly of those three buildings was on average 60 per cent of the cost of new construction at that time[103].

Chapter Four

NEW APPRAISAL TECHNIQUE

An integrated appraisal technique has been developed for the large panel blocks, which takes into account the main factors affecting the condition and suitability of the block. This appraisal technique is built up in a hierarchical form moving from the general approach to particular elements. It enables one to select and study aspects of the situation at whichever level of detail is deemed to be most appropriate. It was decided to use a tree appraisal technique containing four levels of details in order to identify the position of the problems and to rank the tower blocks on a priority scale. Figure 4-1 shows a diagram which represents the tree structure and illustrates the related terminology:

The appraisal technique comprises two main approaches; physical and social appraisals, as shown in figure 4-1. These approaches represent the first level of the appraisal tree model. The integration of results from these two subjects forms the final appraisal result for each tower block and then, in general, shows the large panel blocks problems. The next two sections deal separately with these approaches in more detail. The study cases, the methodology and the sampling technique used are described in the third section.

In this appraisal technique, the following phraseology was established and is used throughout this study:

Category: is a department within the model; eg. "structure" is a category, as is "staircase" in the Physical Appraisal and as "dwelling" in the Social Appraisal;

Level: refers to a particular layer in our model. For instance, the category "Physical appraisal" or "Social Appraisal" is found on the first level;

Approach: refers to all those categories on the first level; eg. "Physical Appraisal" and "Social Appraisal";

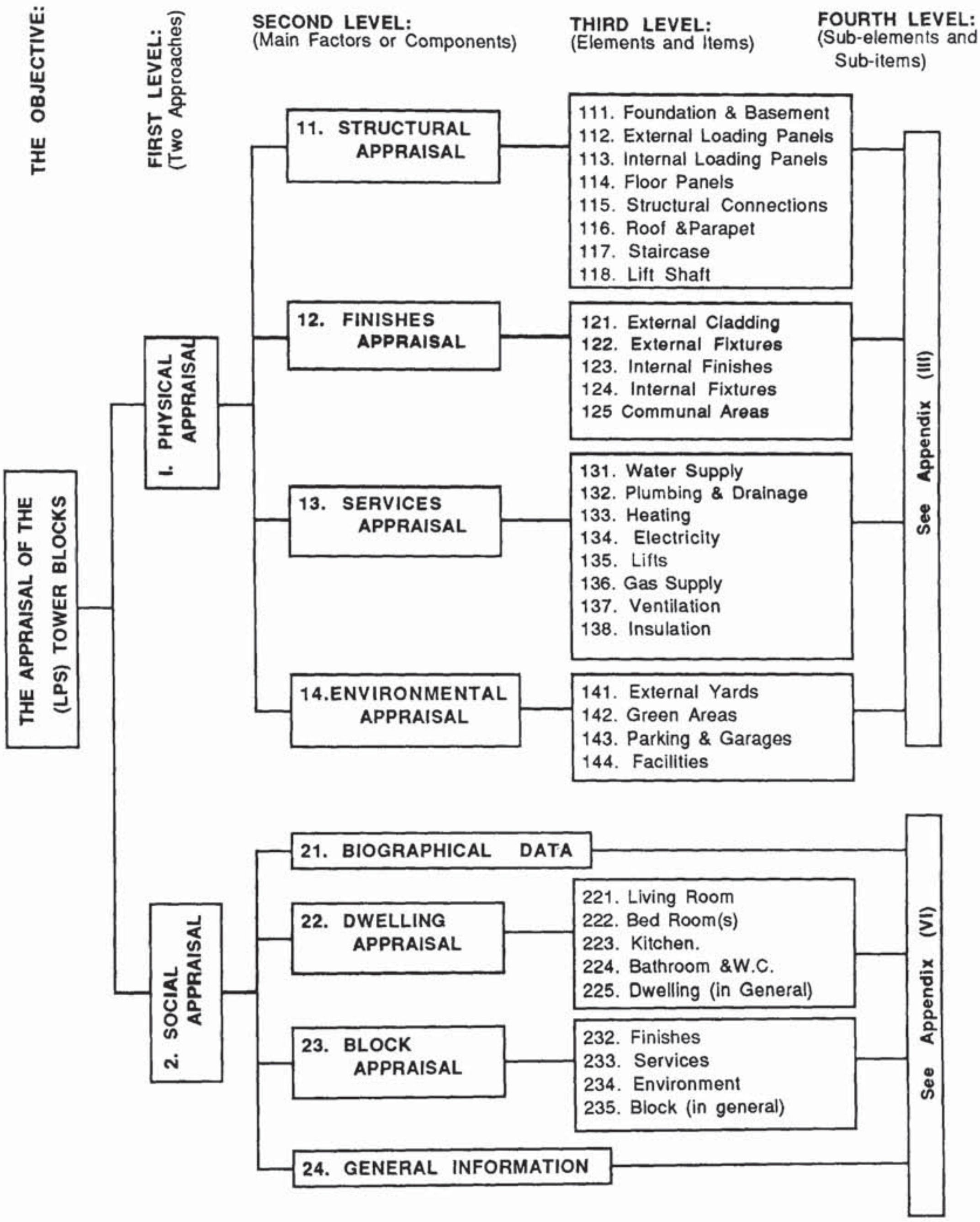

Figure 4-1 The main branches of the Appraisal Tree Model

Component or Factor:	refers to all those categories on the second level of the tree model; For instance "structure", "finishes", etc. in the Physical Appraisal and "the dwelling", etc. in the Social Appraisal;
Element or Item:	refers to all those categories on the third level of the tree model; For instance "floor panel", "water supply", etc. in the Physical Appraisal and "kitchen", Finishes", etc. in the Social appraisal; and
Sub-element or Sub-item:	refers to all those categories on the fourth (bottom) level of the tree model. It refers to the individual categories or questions that are assessed on the site. For instance, "cracking in the floor panel", "ceiling finishes", etc. in the Physical Appraisal and "the physical layout of the bedroom(s) is good", etc. in the Social Appraisal.
Cost Weighting:	The cost weighting (quantity score) is roughly the percentage of the sub-categories cost compared with the original cost of their categories, i.e. the relative original cost relationships between the element, for example, in the third level and its sub-elements in the fourth level. In this study, all the cost weighting of the categories in the appraisal tree model were estimated as a percentage rate.

This is graphically represented in figure 4-1 and Appendices (III) and (VII).

A coding system was introduced so that any category on any particular level could be uniquely identified. For instance, "the lift shaft" is identified as 118 in the Physical Appraisal (represented by 1, the first number), "the physical layout of the living room is good" is identified as 212 in the Social Appraisal (represented by 2, the first number) and so on. The coding of the categories can be seen listed clearly in the Physical Appraisal tick sheets and Social Appraisal Questionnaire, As shown in Appendices (III) and (VII).

4.1 Physical Appraisal

This approach is an essential tool in preparing complete files for every block appraisal; especially when the building is broken down into manageable elements and sub-elements. This technique provides a thorough understanding of the current condition of the block, and an analysis of their make-up. It depends mainly on visual inspection of the blocks, which make the appraisal technique quick and simple to use.

In the physical appraisal approach, the complete building is broken down into four major components: the structure, finishes, services and environment. They are in the second level of the appraisal tree model, these four components are then divided into a third and fourth levels respectively. Figure 4-2 shows the first three levels of the appraisal tree relating to physical and environmental factors. All the other fourth level details are shown in Appendix (III).

From the second level, the structure is divided into eight elements. Each element is then sub-divided into sub-elements to form part of the fourth level of the appraisal tree model. In the same way, finishes, services and environment are divided into five, eight and four items, respectively. Each item is then sub-divided into sub-items, to complete the third and fourth levels of the appraisal tree, respectively, as shown in the figure 4-2 and Appendix (III).

Each of these sub-elements or sub-items represents an important part or question which has effects on, in one way or another, the condition of the elements or items in the third level and then on the physical condition of the block as a whole. In summary, the Physical Appraisal approach contains 143 sub-elements and sub-items covering every physical and environmental factors, deemed relevant for the purposes of this study, relating to the large concrete tower blocks.

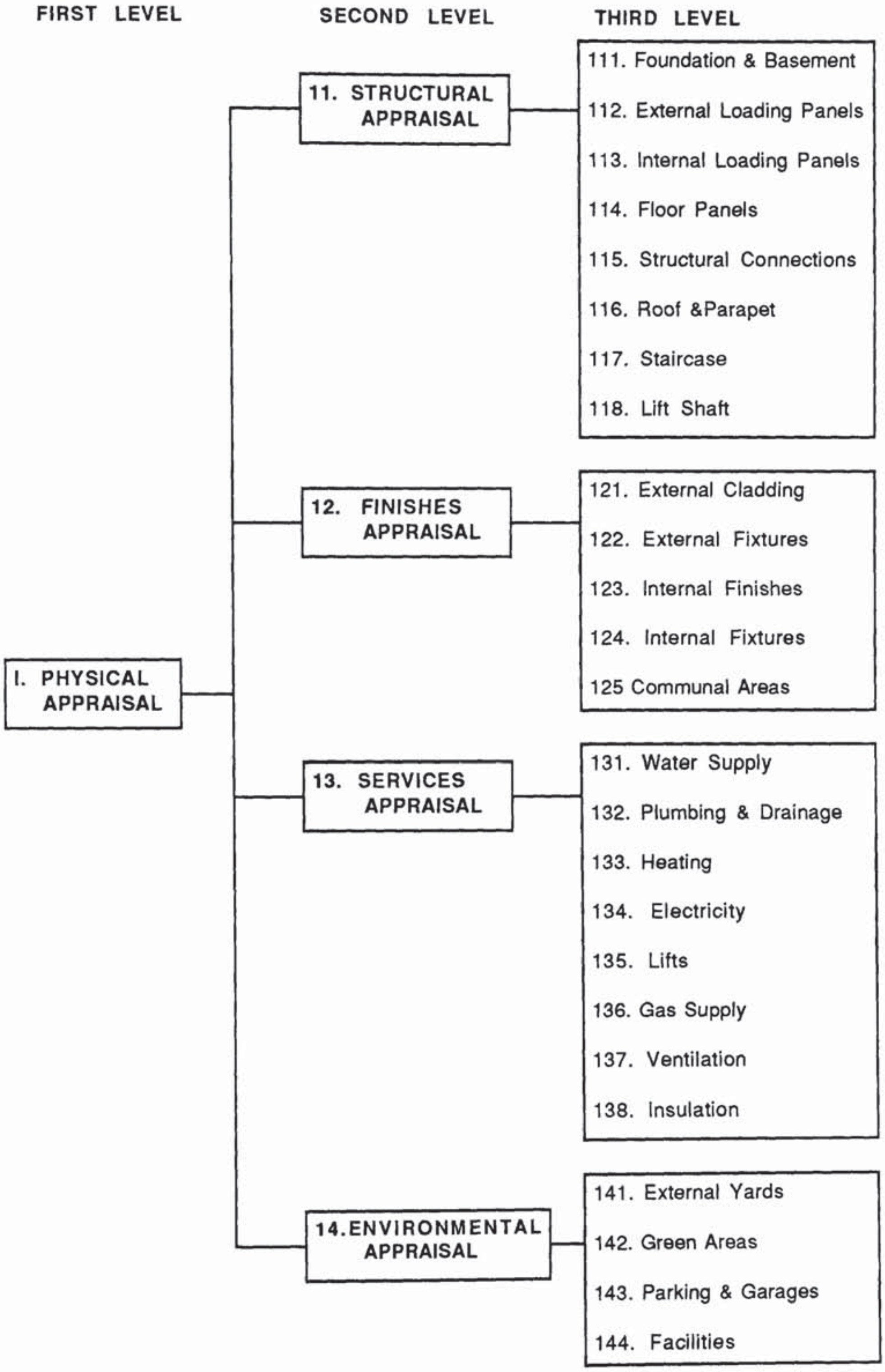

Figure 4-2 First three levels of the Physical Appraisal Approach

4.1.1 Assessment Method:

The quality condition standards used in the physical appraisal operation of every sub-element and sub-item of the fourth level are shown in figure 4-3:

Quality Conditions	E		D		C		B		A	
Sub-conditions	E-	E+	D-	D+	C-	C+	B-	B+	A-	A+
Quality Scores %	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Representative scores	05	15	25	35	45	55	65	75	85	95

Figure 4-3 The Quality Condition Standards

In general, the right-hand side of the form, A, means the best, i.e. the sub-element or sub-item is in very good, or fit condition. The left-hand side, E, means it is in the worst condition, i.e. in very bad, or unfit condition. The assessment letters B, C and D range in between the two. In other words, A was as new, B needed routine maintenance, C needed repair, D required extensive refurbishment and E was unsafe and needed replacement. Each of these five quality condition standard is then divided into two sub-condition (+ and -) for wider range of appraisal and solution, and for the ranking purposes.

In this appraisal method, a quality score system has been developed, mainly for the ranking technique, which depends mainly on the qualitative and quantitative condition of each category in the appraisal tree model. In this system, the scores of examined sub-elements (or sub-items) are rated out of 100 (i.e. as a percentage), with 100 representing the original condition of the category. For example, if B-marked for the category in the appraisal, this means the score of this category is ranged between 61-70 percent of its original condition, which is assumed to be perfect. The average score is fixed for each condition standard to give the representative figure, as shown in the figure 4-3.

After the quality scores have been obtained for all structural sub-elements at the fourth level, the quality scoring of the elements in the third level can be obtained by the following procedure:

Consider the quality score of each sub-element is $\mathbf{X_{ij}}$, where **j** is the sub-element number in the fourth level, and **i** is the number of the element in the third level. $\mathbf{A_{ij}}$ is the cost weighting of the sub-element, which depends mainly on the quantity relations between the sub-element and its element in a percentage rate.

In other words, the cost weighting (quantity score) is roughly the percentage of the sub-element cost compared with the original cost of its element, i.e. the relative original cost relationships between the element in the third level and its sub-elements in the fourth level. In this study, all the cost weighting of the categories in the appraisal tree model were estimated as a percentage rate. This was because the original documentation could not found. Consequently in this estimation, some other references were depended [104,105].

Therefore the element score is:

$$Y_i = \sum_{j=1}^{n} A_{ij} * X_{ij} \quad \text{.............................. Equation (4.1)}$$

Where **n** is the number of sub-elements in the element **i**.

After all elements have been analysed and their quality scores are determined, the structure quality score in the second level can be obtained by using this equation:

$$Z_k = \sum_{i=1}^{m} B_{ki} * Y_i \quad \text{.............................. Equation (4.2)}$$

Where B_{ki} is the cost weighting of the elements **i** derived from the structure component:

m is the number of elements (8 elements in the structure component);

k is the number of component in the second level (the structure component is number 1); and

Z_1 represents the structure appraisal score.

If there is any sub-element or element missing in relation to the appraised block, then the score of the upper level is divided by: (1 - the cost weighting of the missing sub-element or element).

In the same way, the quality score for the finishes, services and environmental appraisals can be obtained from the quality and quantity scores of their sub-items and items.

The final qualitative score of the physical appraisal approach F_1 can be determined from the quality and quantity scores of its four major components using this equation:

$$F_1 = \sum_{k=1}^{4} C_k * Z_k \quad \text{.............................. Equation (4.3)}$$

Where C_k is the cost weighting of the major components; and

F_1 is the Physical Appraisal score (as a percentage) of the tower block.

A data collection form, in the format of a "tick sheets", was used during the appraisal operation. This form contained all of the details for the physical and environmental appraisal levels (see Appendix IV). The form provides a matrix for marking condition standards on a scale of **E-** to **A+**. In addition to that, in the data form there is 'remarks' label. In this label every important note(s) about each sub-elements or sub-items are seen must be reported. Figure 4-4 shows a portion of the Physical Appraisal form used in this study.

BLOCK NAME : **HEIGHT :**
ADDRESS : **CONST. TYPE :**
11.STRUCTURE :

115.STRUCTURAL CONNECTIONS :	E		D		C		B		A		Remarks
1151.Joints Opening/Closing											
1152.Differential Movement of Joints											
1153.Structural Capability of the Joints											
1154.Joints Materials											
1155.Ties in the Joints											

Figure 4 -4 Portion of the Physical Appraisal Form Used

In the appraisal procedure, there is no significant difference between the large panel construction systems, i.e. Bison WF and Fram LP. The principles are the same. Therefore, the effect of the construction systems may be ignored.

In the structural appraisal, we assumed that whilst the construction accords in general with the original drawings. There were no defects or deteriorations of the structural elements. If cracking was observed in the block, an attempt to discover the cause and effect of the cracking was made. This cracking may result in :

1. a loss of building stability;
2. rain penetration;
3. air infiltration;
4. heat loss; and

5. reduced sound insulation.

All of which mean a loss in the efficiency of the building.

The assessment operations were done with the cooperation of the City Architects and Housing Departments. Depending mainly on :

1. Site investigations; where at least ten dwellings at various floors were assessed,. The access routes to all other areas of the blocks was also assessed to complete the physical appraisal form;
2. The results of external survey reports for each block prepared by CAN (UK) Ltd. for the City of Birmingham.
3. The technical reports of the City of Birmingham's Industrial Research Laboratories. These reports concerned an examination of the outer leaf of sandwich wall (facing) panels to the blocks.

An initial appraisal was made of the technique following completion of the assessment for the first block (Barry Jackson Tower). This appraisal now could be used on site for the rest of the large panel blocks. The major failing of previous studies was that, they required a number of highly paid professionals all working together on site for some considerable time. In the new appraisal technique, two or three professionals were envisaged to visit each site. For consistent results the inspectors had to stick to a rigid format and record their finding on a "tick sheets".

Thirteen blocks (as case studies) were appraised by three inspectors from Aston University, with the cooperation of Birmingham City Council, using this new appraisal technique. The results from the three inspectors were ranked according to the scale previously described. This was then converted into a numerical score between 1 and 100 using the representative scores, as shown in figure 4-3. The three results are then averaged. Each category is then weighted and the upper level's categories are calculated. The final qualitative and quantitative score is calculated for each tower block using equations (4-1) to (4-3).

In more detail, let us take as a reference example "Normansell Tower" block: For this block, each inspector submits his own appraisal scores for each sub-element (or sub-item). The average score for each of them is entered into a sheet similar to that shown in figure 4-5, after converting the scores into a representative numerical score.

Figure 4-5 shows the average scores of the structural sub-elements appraisal in a matrix form [X]. Multiply matrix [X] by the cost weighting matrix for these sub-elements [A], in the way of equation (4-1), to get new matrix of results {Y}. This matrix {Y} represents the quality scores for each elements in the third level for the structural component.

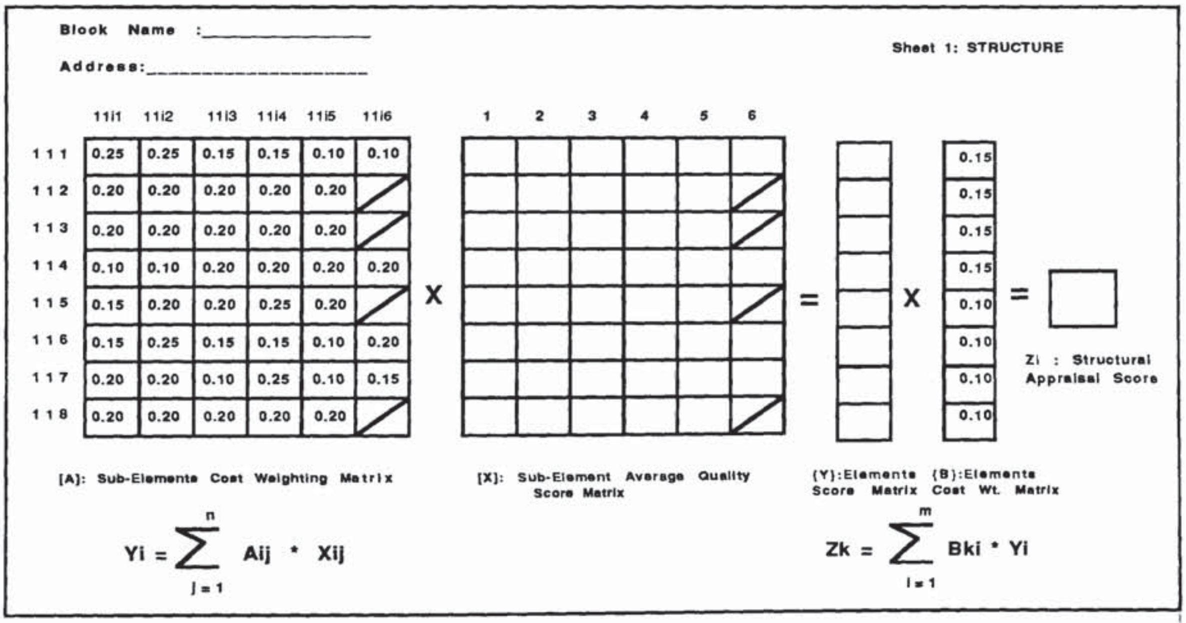

Figure 4 -5 Sheet No. 1: The Method of Calculation for the Structural Appraisal Score

For instance; the staircase element quality score in Normansell Tower can be arrived at as follows:

$$Y_5 = 0.15 * 45 + 0.20 * 55 + 0.20 * 65 + 0.25 * 55 + 0.20 * 65$$

$$Y_5 = \underline{58}$$

This means that the staircase quality condition at the assessment time is equal to **58** percent of its original condition when it was new.

After that, The quality score of structural component can be obtained by multiply matrix {Y} by its cost weighting matrix {B}, in the way of equation (4-2). For the Normansell Tower example, the structural appraisal score was:

$$Z_1 = 0.15 * 81 + 0.15 * 81 + 0.15 * 73 + 0.15 * 74 + 0.10 * 58 + 0.10 * 69 + 0.10 * 65 + 0.10 * 79$$

$$Z1 = \underline{74}$$

This means that the structural condition of the block at the assessment time is equal to **74** percent of the original structural condition of the block when it was new.

Similar procedures must be followed for the other components (i.e. Finishes, Services and Environmental), starting from the average results of each sub-items in them to the components scores. For the example block "Normansell Tower", the quality scores for finishes, services and environmental are **51, 56** and **56** percent respectively, as shown in Appendix (V).

Finally, the quality score for the Physical Appraisal of the block can be obtained from summation of the product of the quality scores of each component and its cost weighting. The final results depend also on the estimated cost weighting for each category on the appraisal tree. Figure 4-6 shows the assumed quantitative relationship (interms of original cost) between the major components in the second level of the appraisal tree model. The structural elements weight is approximately 38 per cent of the whole building cost*. Finishes, services and environment represent approximately 28,24 and 10 per cent of the original cost of the building respectively [104,105].

MAJOR COMPONENTS :	WEIGHTING COST %
11. STRUCTURE	38
12. FINISHES	28
13. SERVICES	24
14. ENVIRONMENTAL	10

Figure 4 -6 The Quantity Weight of Major components

Again for the Normansell Tower block, the Physical Appraisal quality score can be obtained by using equation (4 -3) as follows:

$$F_1 = 0.38 * 74 + 0.28 * 51 + 0.24 * 56 + 0.10 * 56$$

$$F_1 = \underline{62}$$

This means that the physical and environmental condition of Normansell Tower, at the time of assessment, is equal to **62** percent of its original condition when it was new, assuming perfection as completion, or what it is supposed to be.

There are five sheets needed to compute the final quality score for the Physical Appraisal approach for each block, where figure 4-5 represents the first sheet of these. The total model of the example is included in Appendix (V) for Normansell

* The structural percentage may change from low to high storeys buildings, and range between 35-40 per cent of the building cost. in the case studies calculations, the above cost weight is fixed.

Tower block using the system described. The same procedure was applied to the rest of the thirteen case studies of blocks and the results will be shown in chapter five.

A computer program was written to cover all the procedures of the Physical Appraisal technique. This program presents the final first and second level results for each block. It is written in Basic and runs on an IBM or compatible machine. The listing of the program and the final results for Normansell Tower are given in Appendix (VI).

4.2 Social Appraisal

The social appraisal technique takes the form of an complementary appraisal tree, which follows the second branch of the main "all inclusive" appraisal tree (see section 4.1 and Figure 4-1). The correlation of human sensations with building factors is usually achieved by asking (either by questionnaire or interviews) numbers of people (normally the residents of the building) to report their satisfaction and attitude to particular or various components of the building and the treatment of the responses statistically.

Therefore, the social appraisal technique in this study was designed as an appraisal questionnaire form. Where, this particular appraisal questionnaire contains a series of four factors (components) which affect the psychological and social conditions of the users of multi-storey dwelling blocks. They are in the second level of the appraisal tree model, as shown in figure 4-7. These factors are:

1. Biographical Data: This is used to clarify the information from the questionnaire on the basis of important biographical variables. It is an objective to examine the relationship between the nature of tenant satisfaction

and attitude with specific biographical factors (elements). In this study, the biographical data is in the form of a list, not in a hierarchy (see chapter six).

2. Dwelling Appraisal: This component of the social appraisal approach determines residents satisfaction and appraisal of various aspects of the dwelling layout under various categories; such as bed room(s), living room and so on. In addition to the residents attitude to the re-cycling idea (for the

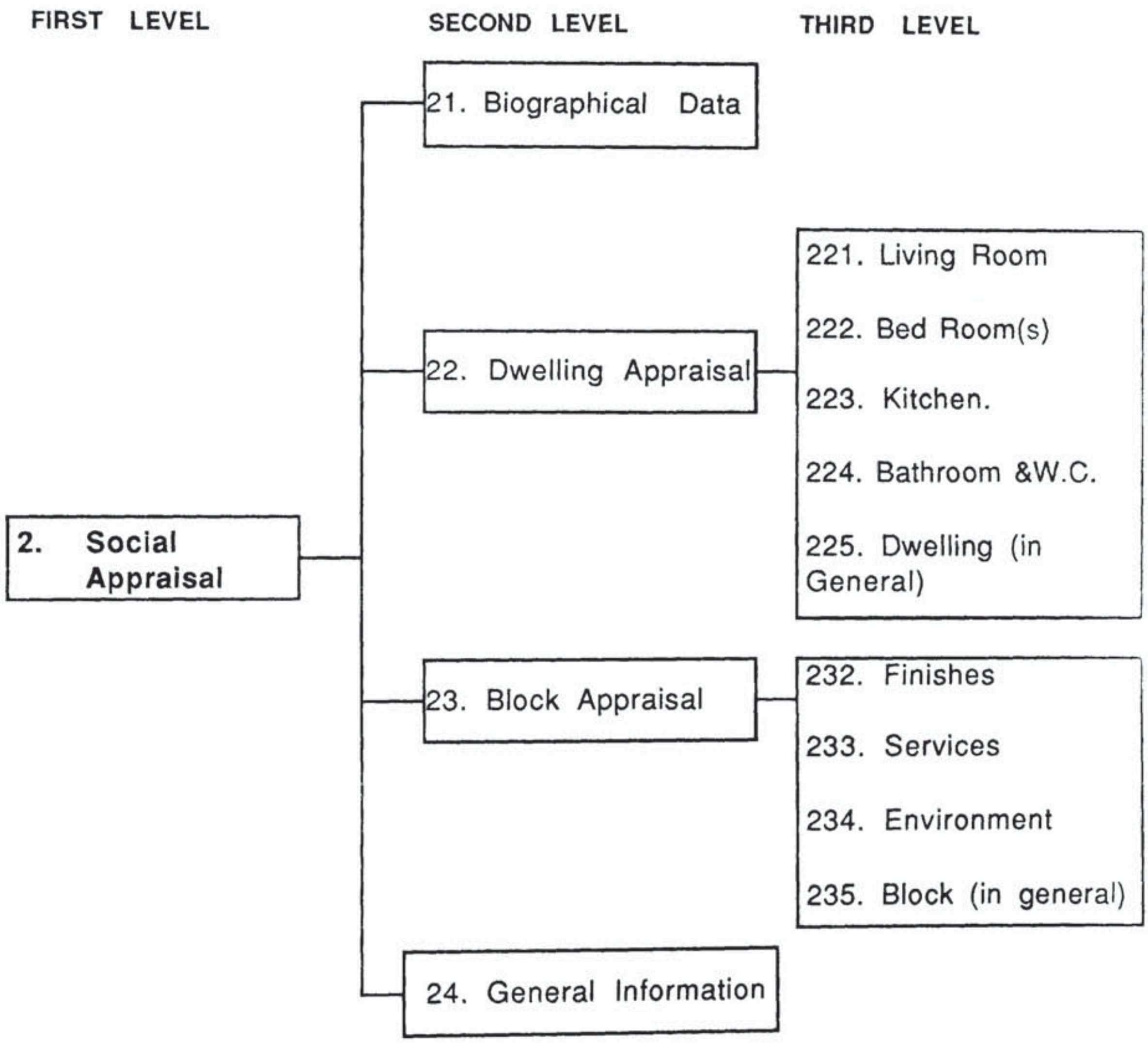

Figure 4 -7 Complementary Appraisal Tree (social Appraisal)

definition, see Chapter three) indirectly. It comprises many elements and sub-elements as third and fourth levels of the appraisal tree model.

3. Block Appraisal: The Purpose of this category is to appraise the physical and environmental factors of the block and its major components; such as finishes, services and so on, and also for the following purposes:
   a. to see how tenants feel about their block and estate (i.e their level of satisfaction);
   b. to establish the general attitude of the residents to the high-rise dwelling blocks; and
   c. to study some other social aspects with respect to this sort of building; such as safety, security and so on.
4. General Information: This is to test some of the main problems of this sort of building, for instance:
   a. the efficiency of the central heating system;
   b. to allow the residents to say what they like about their dwelling, block and estate;
   c. to see what sort of accommodation the people like to live in; and
   d. to study the attitude of people to the new alternative solution (re-cycling) indirectly.

It is in the form of a list of questions which are mainly open ended.

As shown in figure 4-7, Second and third components are divided into many elements. Each of these elements contains several questions (as sub-elements). These questions represent the fourth level of the main appraisal tree model for this approach. It was decided to use a more direct method of questioning, and to limit indirect questions. The full questionnaire is included as Appendix (VII)

In summary, most questions were asked about various aspects of the dwelling, dwelling layout, block finishes, services, re-cycling idea etc. in order to discover where the problems were perceived to lie and what the residents attitudes were and their satisfaction with this sort of building or otherwise.

4.2.1 Why the Questionnaire? :

This section contains a description of the "questionnaire" and why it is used in the social appraisal technique. In general, "the word questionnaire refers to a device for securing answers to questions by using a form which the respondent fills in himself"[106] to serve a specific objective. The purposes for which questionnaires are used, and the type of information sought, vary from study to study. Oppenheim 1966, defines the questionnaire as:

> "A questionnaire is not just a list of questions or a form to be filled out. It is essentially a scientific instrument for measurement and for collection of particular kinds of data. Like all such instruments, it has to be specially designed according to particular specifications and with specific aims in mind, and the data it yields is subject to error. We cannot judge a questionnaire as good or bad, efficient or inefficient, unless we know what job it was meant to do. This means that we have to think not merely about the wording of particular questions, but first and foremost, about the design of the investigation as a whole"[107].

The use of questionnaire in research has many advantages. some of these advantages are listed below:-

1. The Cost: The most obvious benefit of the questionnaire method is cost. The expense of printing questionnaires and distributing them to large numbers of people is considerably less than that of interviewing similar numbers of people.
2. Establishing Contact: Interviewers frequently have difficulty contacting people who are not home during normal hours.

3. Breadth of sample: The use of questionnaires can facilitate collecting data from an extremely large sample in a short period of time, and can cover large number of blocks in various geographic areas.
4. Ease of Completion: Questionnaires usually are more convenient for respondents than other methods used to obtain information directly from people.
5. Ease of Tabulation: Well designed questionnaires can be tabulated easily.
6. Objective Familiarity: Peoples familiarity with the objective of questionnaire format and structure may make completion easier.

These, in addition to other more advantageous procedures, such as less bias, catch the opinion, uniform question presentation with a view to future studies, where one of the basic uses of questionnaires is to point out trends for future study.

The main limitations of the questionnaires are low response rate, reliability and validity, question limitations, prejudice against questionnaires and the unknown respondents who complete the form. For further details, refer to any questionnaire design guide books[107,108].

4.2.2 The Questionnaire Considerations in the Social Appraisal

When designing a questionnaire, always consider the people who will be asked to respond. Several basic considerations make a great difference in the final product. Most of the following considerations were kept in mind during all phases of questionnaire design in this study to get as accurate answers as possible, namely:

1. The study title is put in bold type on the first page of the questionnaire.
2. Begin with a few interesting 'non-threatening' questions to increase the likelihood of the subjects completing the questionnaire.
3. Brief and clear instructions for completing the form are included.
4. Group the components and elements into logically coherent sections.

5. Try to make smooth transitions between sections so the respondant does not get the feeling he is answering a serious of unrelated 'quiz' questions.

6. Avoided putting important items at the end of a long questionnaire.

7. Making the questionnaire as "appealing to the eye" and easy to complete as possible.

8. Numbering the questionnaire categories and pages so the respondent will not become confused while completing the form.

9. Put an identifying mark on each page of the form so that, if one page should get separated from the rest, it can be reattached.

The following are additional suggestions which were considered when writing questionnaire items:-

1. Before asking a question, try to be sure the respondent is capable of giving an accurate answer.

2. Asking for only one piece of information per question.

3. Avoiding using general adjectives, adverbs and words with vaguely defined or double meanings.

4. Avoiding using double negative caused by joining a negative response to a question phrased in the negative. Try to say what we mean directly and concisely.

5. try to construct each question to be so clearly worded that all respondents will interpret it the same way.

The questionnaire was prepared so that it is entirely clear, and means the same to all respondents. Finally, the questionnaire is designed to be attractive, easy to fill out and have adequate space for response, in addition to being legible. "A neat, well organized, attractive questionnaire should increase the response rate"[107]. Such an ideal is hard to achieve, but the value of the results of the study will depend largely on this factor[108]. For the questionnaire details, see Appendix (VII).

4.2.3 The Social Appraisal Questionnaire:

In the social appraisal questionnaire, most of the questions are pre-coded and some of them have open ended answers. As in the physical appraisal approach, a coding system was introduced, so that any category on any particular level could be uniquely identified. In this approach, the first component (i.e. Biographical data) comprises some variables (elements) as being more important than others. These are:

1. Floor: It is a very important variable, especially in consideration of the attitude of people to the multi-storey dwelling blocks. In addition to the testing of the re-cycling idea, and many other related social factors.

2. Size: There are two sizes of dwellings in the study blocks; one bedroom and two bedroom dwellings. This variable is considered to find the differences between them in terms of the level of satisfaction and the main problems perceived.

3. Sex: The sex of respondents is an important variable in the consideration the relationship between the resident satisfaction and the block categories.

4. Age: The range of this variable in between 18 - over 65 years. Reclassified for analysis as being:

   18 -25 years =1

   26 -40 years =2

   41 -64 years =3

   65 years or over =4

5. Marital Status: A limited scale was used in this study, which simply classified as;

   Single =1

   Married =2

Other =3; covering all other marital status, such as widows, widowers, divorcees, separated and so on.

6. Job: This was included to test for differences in reactions between individuals of different social classes. No scale was used in the appraisal form, but in the statistical analysis, the scales used were simply classified for analysis as:

Employed =1

Unemployed =2

Retired =3

Housewife =4 (This term involves a sex variable. The important factor is that these female respondents see themselves as being "housewives" as distinct from being "unemployed".

Others =5

7. Number of Adults and Number of Children:

Important elements influencing the resident satisfaction and appraisal.

8. How long have you lived at this block?

This is to examine possible adaptation effects.

The satisfaction and appraisal measure of dwellings and the blocks is provided in the second and third components of this approach. The elements and their sub-elements of the social approach are arranged in a logical sequence. The aim was to construct an arranged questionnaire to measure the degree of satisfaction and attitudes towards each category of dwelling and block.

The measurement tool used in most questions of the second and third components of the questionnaire is Likert Scales. It eliminates the need for judges by getting subjects in a trial sample to place themselves on an satisfaction scale for each question running from "strongly agree", to "agree", "uncertain", "disagree" and "strongly disagree". These positions are given a limited weight of 5, 4, 3, 2, and 1 respectively for scoring purposes for positively loaded statements. For the negatively loaded statements, the scoring method will be 1, 2, 3, 4 and 5 for "strongly agree", "agree", "uncertain", "disagree", and "strongly disagree" respectively (i.e the reverse applies). It is important to note that in both sets of answers "uncertain" scores 3, which means the respondent is in between the satisfaction and dissatisfaction, as shown in Appendix(VII). Figure 4-8 shows a portion of the social appraisal questionnaire form used in this study.

For the ranking technique, the scales used in the social appraisal approach were converted to a percentage rate for the combination of its results with the

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PART TWO : **Dwelling Appraisal**

Please tick (✓) the relevant box for that statement which best describes your level of satisfaction.

21. Living Room :

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
211. There are no problems arranging and fitting furniture into the living room.					
212. The physical layout of the living room is good.					
213. The number of doors and windows in the living room are satisfactory for daylight and ventilation.					
214. The living room is large enough for day to day use.					
215. You are bothered by noise in the living room.					
216. The living room can be kept warm in winter.					

==

Figure 4 -8 Portion of the Social Appraisal Questionnaire Used

physical appraisal results. This is to get the final inclusive appraisal results for each tower block in terms of a percentage rate. For the equiprobability of each category in the social appraisal approach, the weighting factors for all the categories are the same. Therefore, the percentage rate of the mean score of each element represents the level of satisfaction score, which depends mainly on the mean values of the sub-elements scores.

There are some open ended questions at the end of second and third and in the fourth components. These questions allow the respondents to say anything they wish about their dwelling, block and estate they are living in to help them to express their personal views. These views are taken as a pointer for further studies, but can not be evaluated in term of the current appraisal via ranking technique. For more detail, see Appendix (VII).

4.3 Case Studies:

As previously specified, the study is of the large panel concrete dwelling blocks under the control of Birmingham District Council. Of the total multi-storey dwelling blocks owned by the City approximately 23.4% are of large panel construction type (mostly Bison WF system), as shown in Appendix (II). These sort of blocks range between 9 storeys to 20 storeys height, and their ages are between 24 years (finished at 1964) and 16 years (finished at 1972) old.

From the developed database, which was input into PROXIMA*, and collected from the databases of Departments of City Engineer and City

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* PROXIMA is a fully integrated, interactive micro-computer system developed to aid general administration and project management.

Architect (see Appendix II). Initially, 12 large panel dwelling blocks were chosen as case studies, 2 Fram LP and 10 Bison WF construction systems. These blocks form a representative sample in terms of age and storey height. They are the oldest and youngest tower blocks of each storey height. Whilst the thirteenth case study was added by the City, Netley House. It is one of the Bison system, as shown in table 4-1.

No.	Block Names	HEIGHT	Ds.	1 B *	2 B *	Const. Type	Aq. Date
1.	LAPWORTH HOUSE	13	50	26	24	FRAM LP	1969
2.	DURHAM TOWER	20	80	42	38	FRAM LP	1970
3.	STOKESAY HOUSE	11	42	1	41	BISON WF-TR	1965
4.	NETLEY HOUSE	11	42	1	41	BISON WF	1965
5.	WHEELDON HOUSE	11	43	23	20	BISON WF-280	1971
6.	WESTON HOUSE	13	50	26	24	BISON WF-V	1967
7.	WOBURN HOUSE	13	52	28	24	BISON WF-280	1970
8.	BALDWIN HOUSE	15	58	30	28	BISON WF-NG	1968
9.	ESSINGTON HOUSE	15	60	32	28	BISON WF-CW	1969
10.	DORSET TOWER	18	106	36	70	BISON WF-340	1971
11.	NORMANSELL TOWER	18	106	36	70	BISON WF-340	1972
12.	SALISBURY TOWER	20	116	59	57	BISON WF-V.	1968
13.	BARRY JACKSON TO.	20	118	40	78	BISON WF-340	1972
	Total		923	380	543		

* 1B= One Bedroom Dwellings; 2B= Two Bedroom Dwellings.

Table 4-1 13 Chosen Blocks' Information

At Netley House, some residents brought suits against the City Council in respect of dampness and condensation in their dwellings and were vindicated when a magistrate ruled that £500,000 was necessary to improve their dwellings and fifty others in the block. The City was not able to consider Netley a particular priority and they also feared that it might set a precedent, diverting money away from the higher priority needs of some of the older traditional blocks.

So, the total number of case studies became 13 blocks, 2 Fram LP and 11 Bison WF construction systems, as shown in table 4-1. Table 4-1 shows the oldest and newest blocks were chosen from different heights, starting from 11 storeys until 20 storeys height.

Table 4 -1 shows also the number of dwellings in each of the case study and the specific detail of the Bison WF construction type which depend mainly on the dwelling layout in each block.

4.3.1 Method of Sampling:

The principal objective of any sampling technique is to secure a sample which, subject to the limitations of size, will reproduce the characteristics of the population* (especially those of immediate interest) as closely as possible. Because of the size of the population, it may be either impracticable or impossible for the researcher to produce statistics based on all members. Under circumstances such as these the researcher selects what is called a sample.

A sample is any subgroup or subaggregate drawn by some appropriate method from a population*. The methods used in drawing the sample being important. In general, the methods of sampling take many different forms, as follows:-

1. A Random Sampling;
2. Systematic Sampling;
3. Stratified Random Sampling;

---

* Population is any defined aggregate of objects, persons, or events, the variables used as the basis for classification or measurement being specified. In this study, the population is represented by the residents of the 13 chosen blocks.

4. Proportional Stratified Sample; and

5. Controlled Sampling. (refer to any statistical text book)[109,110]

Having drawn his sample, the researcher utilizes appropriate statistical methods to describe its properties. He then proceeds to make statements about the properties of the population from his knowledge of the properties of the sample. That is, he proceeds to generalize from the sample to the population. The fact that inferences can be made about the properties of populations from a knowledge of the properties of samples is basic in research thinking.

In this study, the building form and construction type are fixed (i.e. Multi-storey dwelling blocks using large concrete panel systems). The only block related factors are the difference in height and age. So, a controlled sampling system was used in choosing the 13 case studies of tower blocks for the appraisal. For each of these blocks and for all blocks, a stratified random sample of 923 dwellings and their residents in the chosen blocks was taken into account to cover all the physical and social categories.

In the appraisal procedure, the physical and social condition of each block is of concern to us. The condition of the whole block may be discussed later on to draw general conclusions by combining the results of the two sets of the appraisal approaches, and then all the chosen blocks. Therefore, we may arrange our samples according to the following main factors:

1. Height of the block :

In this study, 13 blocks with different height and age were chosen. In the physical and social appraisals, we concentrated on the height of the block. Therefore, we have five sets of blocks with different height, as shown in table 4-1. The first three blocks were 11 storeys high. The others, were three with 13 and 20 storeys and two with 15 and 18 storeys. Then, the newest and the oldest block of each height were chosen. The task is to study each of these blocks individually, and then combine the results of each set. The final physical and social conclusions may take into account the condition of all the blocks together.

2. The Size of Dwellings :

As we see in table 4-1, each block has two types of dwelling size (one bedroom and two bedroom flats). The size of the dwelling may well be an important factor, because it could strongly dictate the nature of the population sampled. For example, it could be hypothesised that only people of certain types and specific physical defects of the dwelling are to be found in a two bedroom dwellings, and it may contain a broad distribution of types of people, whilst a one bedroom dwelling may have the reverse.

3. The Location of the Sample :

Samples must be, at least, taken from lower, middle and upper floors. The assumption is made that there will be a relationship between floor height and physical condition or/and residents satisfaction. Despite this, that there is no significant difference between consecutive floors, for example 5 or 6 and 7 or 8. For this reason, we will classify the height of the blocks into lower (which represent the lower one third number of floors in each block), middle and upper floors. For example, in the 15 storey blocks, the locations are as follows:-

Lower	-	Ground, 1st, 2nd, 3rd and 4th floors
Middle	-	5th, 6th, 7th, 8th and 9th floors
Upper	-	10th, 11th, 12th, 13th and 14th floors

The division must be symmetrical for 13 floors. The lower, middle and upper floors will be the 4, 5 and 4 floors respectively. In the physical appraisal approach, the above assumption was taken seriously through the investigations. While, in the social appraisal approach, the trial was to cover the whole block by distributing the social appraisal questionnaire to all dwellings in the block. This was done to take into account the probabilities of all the above main sampling factors.

4. Household Categories

Most of the household categories were considered in the application of the appraisal approaches, such as:-

a. Families with or without children;

b. Adult and mixed;

c. Elderly (over pension age);

d. Male or female household and so on.

This is because the study was concerned with everybody's satisfaction and appraisal of the block in which they are living in.

The physical appraisal approach was carried out according to the above factors and some other documentation from the City, as shown in section 4.1.

The social appraisal approach was carried out to get a maximum possible response to cover the all probabilities of the above sampling factors. In the result, there was a total of around 300 responses in the survey and 268 completed questionnaires were obtained. This gives a response rate of 32 percent, where, there were around 85 empty dwellings. The percentage response rates for the various blocks of case studies are given in table 4-2.

Table 4-2 shows the number of empty dwellings in each study block at the social appraisal time. The response number represents the number of dwellings which from the complete questionnaires were obtained. The percentage rates of the responses range between 18% to 70% of the thirteen case study blocks.

No.	Block Names	HEIGHT	Ds.	Empty D	Resp. No.	%	Type
1.	LAPWORTH HOUSE	13	50	2	16	33	FRAM
2.	DURHAM TOWER	20	80	18	11	18	FRAM
3.	STOKESAY HOUSE	11	42	2	17	43	BISON
4.	NETLEY HOUSE	11	42	2	20	50	BISON
5.	WHEELDON HOUSE	11	43	2	29	70	BISON
6.	WESTON HOUSE	13	50	10	9	23	BISON
7.	WOBURN HOUSE	13	52	10	14	33	BISON
8.	BALDWIN HOUSE	15	58	9	16	33	BISON
9.	ESSINGTON HOUSE	15	60	2	34	59	BISON
10.	DORSET TOWER	18	106	2	20	19	BISON
11.	NORMANSELL TOWER	18	106	12	28	30	BISON
12.	SALISBURY TOWER	20	116	2	26	23	BISON
13.	BARRY JACKSON TO.	20	118	12	28	26	BISON
	Total		923	85	268	32	

Table 4-2 13 Chosen Blocks' Responses

The most important statistical techniques used in the analysis of the physical and social appraisal approaches are described briefly in the next chapters, together with the discussion of the main results from the physical and social appraisal approaches.

Chapter Five

RESULTS AND DISCUSSION I:

Physical Appraisal Approach

5.1 The Main Findings:

It can be seen that the physical appraisal approach adopted in the case studies indicates a number of general problems and defects relating to large panel dwelling blocks. The frequency with which these defects occurred varied between blocks yet many of them were common to the majority of the blocks surveyed. The main problems and defects can be summarised according to the appraisal tree form (see chapter four) as follows :

1. Structural elements :

a. Generally, in most case studies, no deterioration of the structural elements was observed, i.e. the general structural condition of the elements was reasonably sound with the exception of a few cases of poor workmanship.

b. Structural connections were generally considered to be the main problem. This was in terms of material and workmanship. The in-situ concrete was poorly compacted, which led to the opening of joints. Mastic sealant became debonded, thus allowing rainwater ingress, see plate 5-1.

c. In some positions, the staircase was poorly tied into the main structure.

d. In some blocks, the survey indicated major problems with the roof. The asphalt was found to be in poor condition and was laid over expansion joints. This defect caused water penetration through the roof and balconies, which often emerged some distance away from the source, having travelled by paths in the structure that are difficult to detect.

e. In some loadbearing and parapet panels, low concrete cover to the reinforcement was observed. This had given rise to local cracking and spalling due to the corrosion of the reinforcement as a result of carbonation of the concrete.

f. One block, Lapworth House, shows failure has occurred at the junction of the floor units and external bearing panels.

g. One block, Salisbury Tower, has unstable compartment walls between some flats.

In general, serious structural deterioration has not found in these case studies so far, which means that there were no obvious sign of structural distress.

Plate 5-1 Structural connection and external fixture defects

2. Finishes :

a. Both the CAN UK reports and the physical appraisal approach used, show that the external state of the concrete cladding units was good, with relatively few localised incidents of spalling and damage.

b. Both the technical reports of the City and the physical appraisal approach used show that ties between the inner and outer leaves of the external wall panels caused serious concern, e.g. there were insufficient ties per panel, or the ties were of unsuitable materials or embedding inadequate. Both of these faults were found to be at variance with the original specifications and on occasions differed from one block to another.

c. External Fixtures were seen to be in poor condition. The deterioration of window and door fabrics and the absence of mastic sealant, for instance, led to damp and water penetration, see plate 5-1.

d. Communal areas were often in need of improvements and periodical maintenance.

e. In some blocks, there were signs of local cracking and spalling, for example at the edges of corners of panels and around openings. It was usually associated with low concrete cover to the reinforcement, with high chloride contents or handling damage.

f. In some cladding panels, there are hollow areas beneath the mosaic tiles, presumable due to poor manufacture of the original panels.

g. Some blocks display bitumen patches, especially those with an exposed aggregate finish. Other blocks with painted exteriors show signs of deteriorating paintwork.

h. Within some blocks, vandalism is common. Damage includes broken light units, graffiti, broken louvres, broken partitions, damaged door furniture and various other acts of petty vandalism.

i. Many of the lift landings are badly lit due to both insufficient numbers of light units and vandalism to those which were provided.

In general, the main problems with the finishes were the condition of the cladding and the communal areas, especially the safety and security systems, in addition to badly fitting doors and windows.

3. Services :

a. Problems of condensation are common and have the effect of worsening the dampness. Five factors influence the extent to which dwellings are prone to condensation, these are heating; ventilation; water vapour emission; thermal insulation and thermal capacity of the structure[53]. In fact, condensation in the dwellings is caused by a combination of shortcomings in the prevailing building design, present social behaviour and economic factors.

b. Some blocks were shown to have better ventilation characteristics than others.

c. With the exception of three blocks, the gas supplies were disconnected from all blocks covered in the case studies following advice from the Ministry of Housing and Local Government[49].

d. The main form of heating used in dwellings was portable electric fires. These were preferred by the tenants to the central and underfloor heating due to the perceived high associated running cost.

e. Inadequate sound insulation between dwellings was a problem, and this depended on the position of the dwelling and block, as well as the actual tenants.

f. Where lifts had not been refurbished, the carriages are dirty and unpleasant to use. Also many blocks are not served by a lift to the top floor. This is due to the design of some tower blocks, where the lift motor gear is located on the top occupied floor.

g. In some study blocks, extractor fans in bathrooms and toilets fail to work efficiently.

In general, the major services problem was that of the central heating systems. The central heating systems in use in the thirteen case study blocks are:

1. Electric underfloor heating (EUF):

Often appears to be expensive to operate (with a few exceptions) and inefficient, and unable to supply enough heat with apparently "cold spots" where the system has failed. Underfloor heating systems are now around 20 years old and are reaching the end of their natural life.

2. Electric ducted air storage (EDA):

Operating on a night charging and storage system these large units can be used during the day to blow out warm air. Problems include cost (again, with a few exceptions) and the size of the unit, as during cold weather the stored heat is not sufficient to last throughout the day, long response times taking 2 to 3 days to warm up and the hot air stains the decorated surfaces.

3. Electric storage radiators (ESR):

Similar to the domestic form of storage heater available today. These units appear to work well. Again problems encountered include cost, response time and heat output with many elderly resident not fully understanding how they operate and how to use them to suit their requirements or efficiently.

4. Gas fired central heating:

This system is in use in only three of the newer blocks. It was efficient and residents were pleased with its cost and its performance.

5. Additional sources:

These include the electric radiator installed by the city, or by the M.E.B. and payed for by the residents. Together with portable sources including electric convector heaters, paraffin heaters and (in at least one case) L.P.G. heater.

Table 5-1 shows the central heating systems were found in the case study blocks. It includes the construction types and the height of each block.

No.	Block Names	HEIGHT	Age	Central Heating System	Con. Type
1.	LAPWORTH HOUSE	13	19	Electric Underfloor heating	FRAM
2.	DURHAM TOWER	20	18	Electric Ducted Air storage	FRAM
3.	STOKESAY HOUSE	11	23	Electric Underfloor heating	BISON
4.	NETLEY HOUSE	11	23	Electric Underfloor heating	BISON
5.	WHEELDON HOUSE	11	17	Gas Fired central heating	BISON
6.	WESTON HOUSE	13	21	Electric Underfloor heating	BISON
7.	WOBURN HOUSE	13	18	Electric Storage Radiators	BISON
8.	BALDWIN HOUSE	15	20	Electric Underfloor heating	BISON
9.	ESSINGTON HOUSE	15	19	Electric Storage Radiators	BISON
10.	DORSET TOWER	18	17	Electric Ducted Air storage	BISON
11.	NORMANSELL TOWER	18	16	Gas Fired central heating	BISON
12.	SALISBURY TOWER	20	20	Electric Underfloor heating	BISON
13.	BARRY JACKSON TO.	20	16	Gas Fired central heating	BISON

Table 5-1 Central heating systems used in the 13 case studies

4. Environment :

a. The external yards were often in need of improvement by local authority.

b. Garages were sometimes vandalised or simply neglected.

c. Childrens' play areas and adequate shopping and health facilities were seen to be lacking.

d. Noise pollution from motorway, railways and roads contributed to the discomfort some tenants.

e. Not all the case study blocks contain resident caretakers and/or wardens.

f. Some blocks have scaffolding erected around the entrances to guard against falling cladding materials. This is extremely unsightly and a better solution needs to be found.

g. Originally blocks were designed for residents to have access to the roofs to dry clothing. This proved to be unsatisfactory due to distance involved and theft. Later blocks provide drying areas on each floor, though some blocks no longer provide this facility.

h. There was no public phone in some study blocks, and if there is, the main problem was with vandalism in connection with it.

These were the main defects which have been encountered from the thirteen study cases by using the physical appraisal technique. The question, now, which of these blocks has the priority in any remedial action? The next section deals with the results of ranking technique which is provided in this study.

5.2 Blocks Ranking

According to the physical appraisal scoring system used in this study (see chapter four), the quality scores for the four major components; structure, finishes, services and environmental, in addition to the final physical appraisal score for each block in the case studies, were calculated. Table 5-2 shows these conditional quality scores and includes the name, construction type, height and age of each case study.

As shown in table 5 -2, the final quality scores for the physical appraisal approach range between 75 % (for Essington House - highest score) and 62 % (for Normansell Tower - lowest score). Each of these scores depends mainly on the differences in the combination of obsolescence, lack of planned maintenance, design and construction faults, tenant mis-use, defects, vandalism and so on for each of case study blocks, which have rendered the blocks in their current state.

No.	TOWER BLOCK NAMES	STOREYS No.	1.STRUCTURE	2.FINISHES	3.SERVICES	4.ENVIRON.	TOTAL SCORE	CONSTRUCTION TYPES	AGE (YEARS) 1988
1.	LAPWORTH HO.	13	66	66	58	67	64	FRAM LP	19
2.	DURHAM HOUSE	20	71	58	68	75	67	FRAM LP	18
3.	STOKESAY HO.	11	70	61	59	64	64	WF-TR BISON	23
4.	NETLEY HOUSE	11	70	67	65	61	67	WF BISON	23
5.	WHEELDON HO.	11	74	72	77	76	74	WF-280 BISON	17
6.	WESTON HOUSE	13	72	70	66	69	69	WF-V. BISON	21
7.	WOBURN HOUSE	13	73	70	69	70	71	WF-280 BISON	18
8.	BALDWIN HO.	15	74	68	71	75	72	WF-NG BISON	20
9.	ESSINGTON HO.	15	74	73	77	77	75	WF-CW BISON	19
10	DORSET TOWER	18	71	63	61	71	66	WF-340 BISON	17
11	NORMANSEL TO.	18	74	51	56	56	62	WF-340 BISON	16
12	SALISBURY TO.	20	73	67	75	71	72	WF-V. BISON	20
13	BARRY JACKSON	20	73	67	70	72	71	WF-340 BISON	16

Table 5-2 Physical Appraisal Scoring Results of the 1 3 Case Studies

In the structural appraisal; it seems there is no big difference between the study blocks, as shown in table 5-3 (except for Lapworth House). The main reasons behind this are most of these blocks were constructed within the same period (between 1965-1972) and the company which produced the structural elements was the same, except for the Lapworth House and Durham Tower.

No.	Block Names	HEIGHT	Age	Structural Quality Scores	Con. Type
1.	LAPWORTH HOUSE	13	19	**66**	FRAM
2.	NETLEY HOUSE	11	23	**70**	BISON
3.	STOKESAY HOUSE	11	23	**70**	BISON
4.	DORSET TOWER	18	17	**70**	BISON
5.	DURHAM TOWER	20	18	**71**	FRAM
6.	WESTON HOUSE	13	21	**72**	BISON
7.	BARRY JACKSON TO.	20	16	**73**	BISON
8.	SALISBURY TOWER	20	20	**73**	BISON
9.	WOBURN HOUSE	13	18	**73**	BISON
10.	BALDWIN HOUSE	15	20	**74**	BISON
11.	ESSINGTON HOUSE	15	19	**74**	BISON
12.	NORMANSELL TOWER	18	16	**74**	BISON
13.	WHEELDON HOUSE	11	17	**74**	BISON

Table 5-3 Ascending structural quality order of the 13 case studies

Table 5-3 shows the ranking orders of blocks according to their structural appraisal scores, in ascending quality order. It is clear that there is a relationship between the age of the block and its structural condition, and there seems to be no correlation between the height of the block and its structural condition, as shown in table 5-3 and figure 5-1.

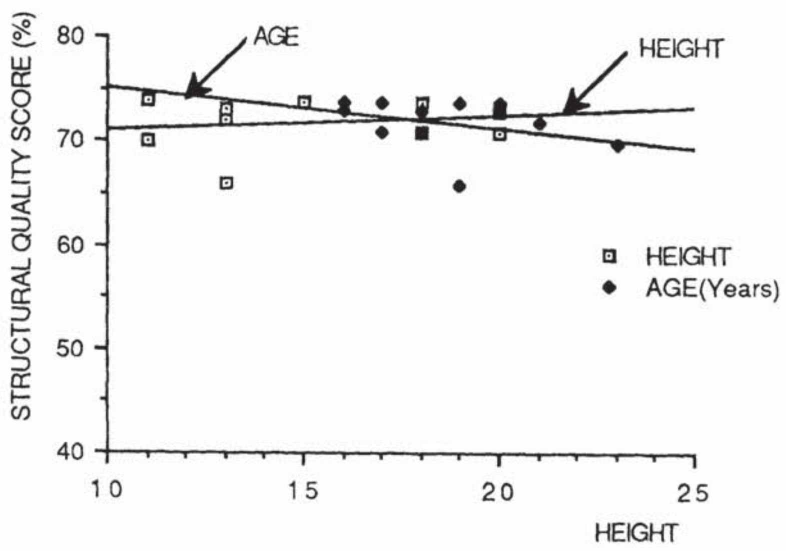


Figure 5-1 The relationship between the age, height and the structural condition of the 13 case study blocks

In the finishes appraisal; Table 5-4 shows the ranking orders of the thirteen study blocks according to their finishes appraisal scores, in an ascending quality order.

As shown in this table there are big differences in the finishes quality scores between the study blocks. The worst one in the finishes items is Normansell Tower (its quality score is 51%). This is mainly due to the high incidence of multi-directional cracking in the external tile cladding (49 instances), as the CAN UK report shows. This combined with the technical report, of the City, which shows 61 of the concrete panels needing attention (due to corrosion of the ties between the inner and outer leaves of the exterior panels). This indicates that the external cladding is suspect and requires some degree of remedial work.

With regards to the internal fabric of the block there are a variety of less serious defects such as inadequate security for the main door and for the lift motor room and poor standards of decoration throughout the communal areas. In addition there are other finishes categories which affect the finishes quality score in one way or another (see Appendix-IV).

No.	Block Names	HEIGHT	Age	Finishes Quality Scores	Con. Type
1.	NORMANSELL TOWER	18	16	**51**	BISON
2.	DURHAM TOWER	20	18	**58**	FRAM
3.	STOKESAY HOUSE	11	23	**61**	BISON
4.	DORSET TOWER	18	17	**63**	BISON
5.	LAPWORTH HOUSE	13	19	**66**	FRAM
6.	BARRY JACKSON TO.	20	16	**67**	BISON
7.	NETLEY HOUSE	11	23	**67**	BISON
8.	SALISBURY TOWER	20	20	**67**	BISON
9.	BALDWIN HOUSE	15	20	**68**	BISON
10.	WESTON HOUSE	13	21	**70**	BISON
11.	WOBURN HOUSE	13	18	**70**	BISON
12.	WHEELDON HOUSE	11	17	**72**	BISON
13.	ESSINGTON HOUSE	15	19	**73**	BISON

Table 5-4 Ascending finishes quality order of the 13 case studies

The best of the case study blocks, in the finishes appraisal score is Essington House (the quality score for its finishes component is 73%). This is because the block has recently been refurbished to some extent. The other 11 blocks come in between, with their quality scores for the finishes category ranging between 58 to 72%. From these results, there seems to be no correlation between the age, height of the blocks and the condition of the finishes component in the blocks, as shown in table 5-4.

In the services appraisal; Table 5-5 shows the ranking orders of the thirteen study blocks according to their services appraisal scores, in an ascending quality order.

As shown in the table 5-5, there are differences in the services quality scores between the study blocks. The lowest scoring one in the services items is Normansell Tower (56%). This is mainly because there are many problems in the services categories; such as old lifts, inadequate ventilation, inefficient heating system, bad condition of electrical installation, inadequate insulation (both sound and thermal) and so on.

No.	Block Names	HEIGHT	Age	Services Quality Scores	Con. Type
1.	NORMANSELL TOWER	18	16	**56**	BISON
2.	LAPWORTH HOUSE	13	19	**58**	FRAM
3.	STOKESAY HOUSE	11	23	**59**	BISON
4.	DORSET TOWER	18	17	**61**	BISON
5.	NETLEY HOUSE	11	23	**65**	BISON
6.	WESTON HOUSE	13	21	**66**	BISON
7.	DURHAM TOWER	20	18	**68**	FRAM
8.	WOBURN HOUSE	13	18	**69**	BISON
9.	BARRY JACKSON TO.	20	16	**70**	BISON
10.	BALDWIN HOUSE	15	20	**71**	BISON
11.	SALISBURY TOWER	20	20	**75**	BISON
12.	ESSINGTON HOUSE	15	19	**77**	BISON
13.	WHEELDON HOUSE	11	17	**77**	BISON

Table 5-5 Ascending services quality order of the 13 case studies

The best two case studies in the services appraisal score were Essington House and Wheeldon House (the quality score for their services component is 77%). Mainly because the blocks have recently been refurbished to some extent. The other 10 blocks come in between, where their quality scores for the services category range between

58 to 75%. From these results, there seems to be no correlation between the age, height of the blocks and the condition of the services component in the blocks, as shown from table 5-5.

In the environmental appraisal; Table 5-6 shows the ranking orders of the thirteen study blocks according to their environmental appraisal scores, in an ascending quality order.

No.	Block Names	HEIGHT	Age	Services Quality Scores	Con. Type
1.	NORMANSELL TOWER	18	16	**56**	BISON
2.	NETLEY HOUSE	11	23	**61**	BISON
3.	STOKESAY HOUSE	11	23	**64**	BISON
4.	LAPWORTH HOUSE	13	19	**67**	FRAM
5.	WESTON HOUSE	13	21	**69**	BISON
6.	WOBURN HOUSE	13	18	**70**	BISON
7.	DORSET TOWER	18	17	**71**	BISON
8.	SALISBURY TOWER	20	20	**71**	BISON
9.	BARRY JACKSON TO.	20	16	**72**	BISON
10.	BALDWIN HOUSE	15	20	**75**	BISON
11.	DURHAM TOWER	20	18	**75**	FRAM
12.	WHEELDON HOUSE	11	17	**76**	BISON
13.	ESSINGTON HOUSE	15	19	**77**	BISON

Table 5-6 Ascending environmental quality order of the 13 case studies

As shown in the above table, there are differences in the environmental quality scores between the study blocks. The lowest environmental score is again Normansell Tower (its quality score is 56%). This is mainly because there are many problems among its environmental categories; such as its external paved and landscaped areas are poor, limited parking availability, and shopping and other facilities are poor etc..

The best of the case studies in the environmental appraisal score is again Essington House (the quality score for its environmental component is 77%). This is mainly because the block has recently been refurbished to some extent and is also situated in a "good" area. The other 11 blocks come in between, where their quality scores for the environmental category range between 61 to 76%. From these results, their seems to be no correlation between the age, and height of the blocks and the condition of the environmental component of the blocks, as shown from table 5-6.

In general, as shown in table 5-2 and figure 5-2, The lowest scoring of the 13 case studies in the aggregated physical appraisal approach is Normansell Tower (its final physical quality score is 56% - C+). This result was mainly caused by the

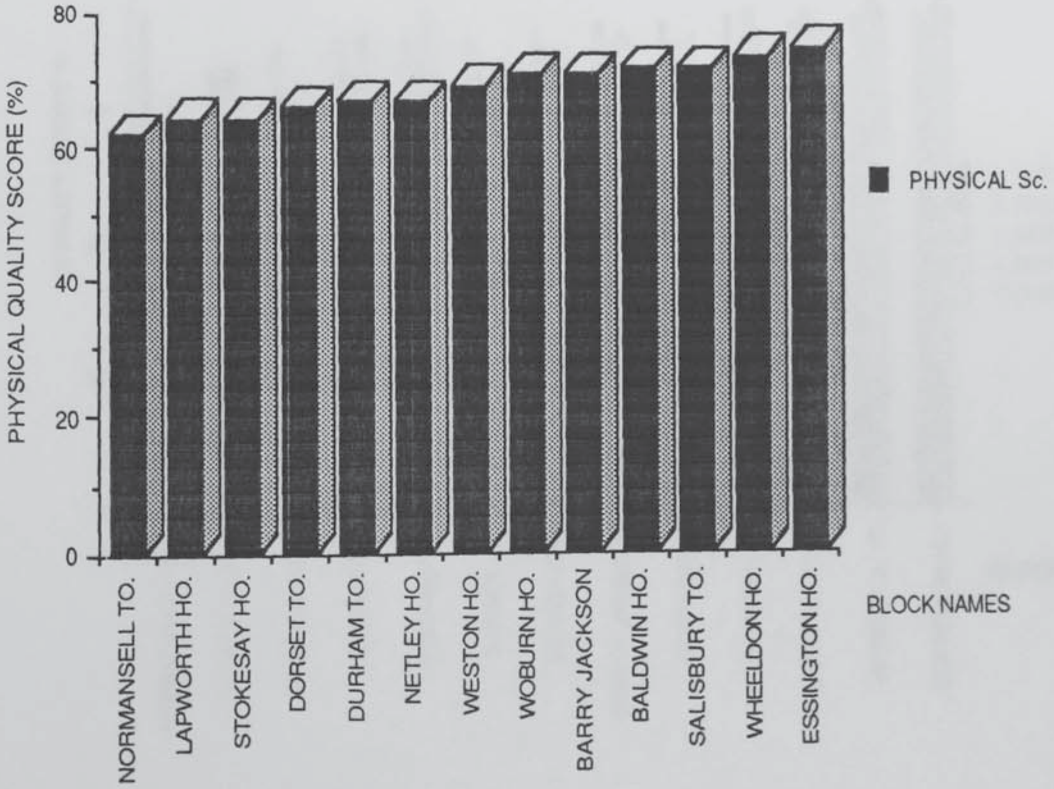


Figure 5-2 The ascending order of the 13 case studies due to the physical appraisal quality score.

problems in its all physical appraisal categories which exceed these for other blocks. Consequently it should be prioritised higher than the other study blocks. Where, the best block of the case studies in the physical appraisal approach is again Essington House (the quality score for its physical appraisal approach is 77% - B+). This is due to the many physical and environmental factors mentioned before.

The final highest and lowest scoring of the case studies will be discussed in more detail later on after the integration of the physical appraisal results with the social appraisal results (the following chapters deal with this).

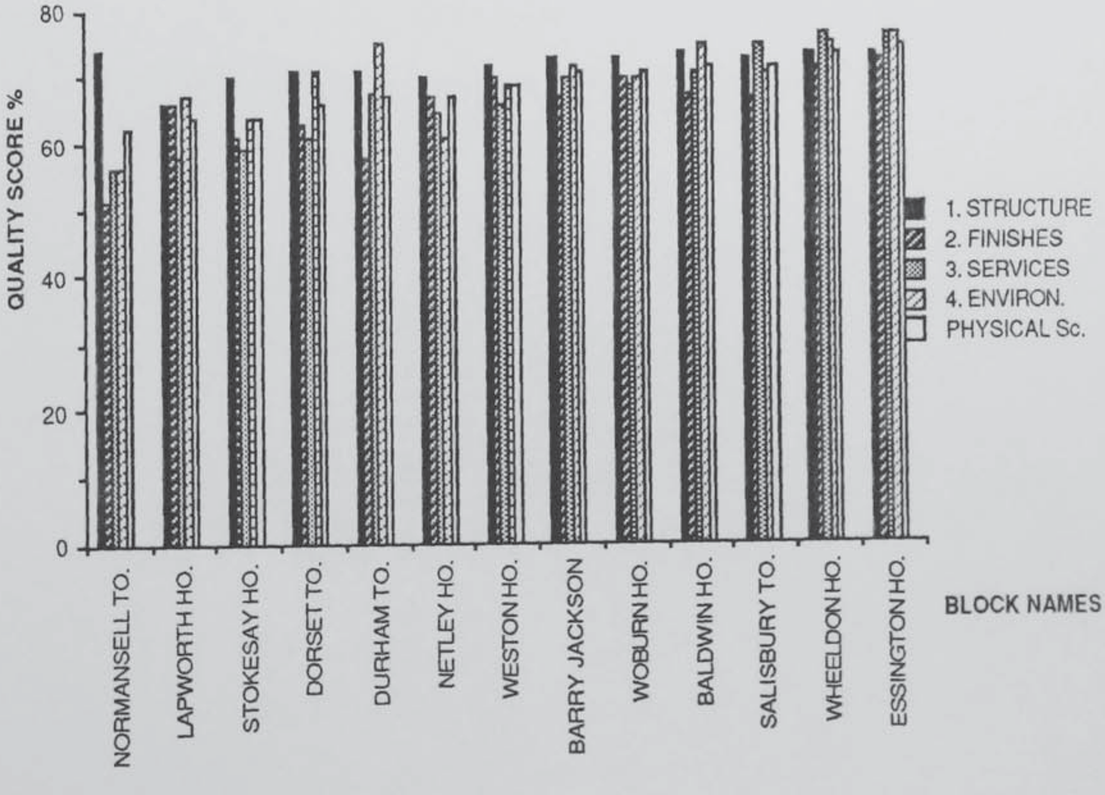


Figure 5-3 The quality scores of the 13 case studies for the physical appraisal approach and its four major components

Figure 5-2 shows the ascending (priority) order of the 13 case study blocks according to the physical appraisal approach. While, figure 5-3 shows the differences in the quality score for the 13 case studies of the physical appraisal approach and its major components; structure, finishes, services and environmental appraisal all together. The blocks are arranged in an ascending order due to the final quality scores of the physical appraisal approach.

Chapter Six

RESULTS AND DISCUSSION II:
(A) Social Appraisal Approach

This chapter includes the analysis of the social appraisal approach data. It is organized into four sections:

1. Description of specific biographical data and housing-related characteristics of the residents, depending mainly on the results of the first component of the social appraisal questionnaire, see chapter four and Appendix (VII).

2. Residents' satisfaction and attitude toward the dwelling and its layout categories, depending mainly on the second component of the social appraisal questionnaire, see chapter four and Appendix (VII).

3. Residents' satisfaction and attitude toward the block, its layout categories and the estate, depending mainly on the third component of the social appraisal questionnaire, see chapter four and Appendix (VII).

4. The case study blocks ranking derived from the social appraisal results only.

In the analysis of social appraisal data, the following statistical techniques were used:

a). Descriptive statistical procedures, such as; frequency counts, percentages, ranges, standard deviations and means.

b). An 0.01 level of confidence was used for determining statistical significance in testing some social and physical variables. Analysis of variance and t-test analysis were used to compare significant differences.

c). Pearson correlation-coefficient (r-coefficient) and Kendall's Tau (t) correlation were used to compare and summarize the relationships between pair of variables.

d). The use of a multivariate statistical technique of multiple regression was believed to be appropriate, because it permitted examination of the individual and collective contribution of the independent variable, which were classified as biographical characteristics of the household, dwelling related characteristics of households and social, physical and environmental aspects of high-rise living, on the variance of the dependent variable, which were Residents' satisfaction and/or attitude towards multi-storey dwelling block. It also permits the examination and summary of the effects of these independent variables on the other individual variables.

The social appraisal variables were coded for the SPSSx system files and listed in the Appendix (IX). These variables were analysed using two main statistical packages. These were:

a). SPSSx (VAX Cluster): This program is a set of instructions to the computer for doing statistical analysis. The SPSSx acronym stands for the Statistical Package for the Social Sciences, version x. In this study SPSSx was run on a mainframe computer (VAX Cluster) at Aston University, Computer Centre [109,110].

b). StatWorks (Macintosh plus): A statistical package was run on a Macintosh Plus computer. This was a complementary or/and checking to some variables of the SPSSx output

6.1 Description of Biographical Data Characteristics of the residents:

The factors of biographical data (household composition) that were studied, as shown in Appendix (VII), were: the size of dwellings, the sex of respondents (i.e. the reference person), the age of respondents, their marital status, their occupation, the number of people living in dwelling, the number of children (under 16 years) living in dwelling and the duration of dwelling occupancy.

1. Size of Dwelling:

This sort of building is made up mainly of two sizes of dwelling; one and two-bedroom. Table 6-1 shows the actual number of these dwelling sizes in each case study block, the number and percentage of the size of dwelling for which results were obtained.

				Actual Rates		Responses Rates		% of Responses	
No.	Block Names	Ht.	Ds.	1B*	2B*	1B*	2B*	1B*	2B*
1.	LAPWORTH HOUSE	13	50	26	24	6	10	38	62
2.	DURHAM TOWER	20	80	42	38	6	5	46	54
3.	STOKESAY HOUSE	11	42	1	41		17	0	100
4.	NETLEY HOUSE	11	42	1	41	1	19	5	95
5.	WHEELDON HOUSE	11	43	23	20	15	14	52	48
6.	WESTON HOUSE	13	50	26	24	5	4	56	44
7.	WOBURN HOUSE	13	52	28	24	5	7	36	50
8.	BALDWIN HOUSE	15	58	30	28	4	8	25	50
9.	ESSINGTON HOUSE	15	60	32	28	17	16	50	47
10.	DORSET TOWER	18	106	36	70	4	14	20	70
11.	NORMANSELL TOWER	18	106	36	70	7	19	25	68
12.	SALISBURY TOWER	20	116	59	57	13	13	50	50
13.	BARRY JACKSON TO.	20	118	40	78	10	18	36	64
	Total		923	380	543	93	164	35	61

* 1B= One Bedroom Dwellings; 2B= Two Bedroom Dwellings.

Table 6-1 13 Chosen Blocks' Size of Dwelling Responses

Of the total 268 respondents in this study, a majority 164(61%) occupied two bedroom dwellings, 93 (35%) occupied one-bedroom dwellings. Only 3% of the total respondents did not answer or comments on this question, as shown in table 6-1.

These percentages are quite representative of the actual ratio of one and two-bedroom dwellings [380 (41%) one-bedroom dwellings and 543 (59%) two-bedroom dwellings in the 13 case study blocks]. For each case study block, most of the responses ratio of the one and two-bedroom dwellings and the actual ratio are almost the same, as shown in table 6-1.

2. Sex of Respondents:

Of the total 268 respondents, the majority (56%) were female, whilst approximately (40%) were male. Four percent of the respondents did not answer or comment on this question, as shown in table 6-2.

Table 6-2 shows the sex structure of the responses in each block and of the total number of respondents, as percentage rates. In most of case study blocks (except Durham Tower) the percentage of female respondents was greater than male respondents. In Essington House and Barry Jackson, the percentages are almost the same.

3. Age of Respondents:

The average age for the respondents was around 54 years. Of the total 268 respondents, the majority (48%), were elderly people (65 years or over). Twenty four percent were between 41-64 years. Fifteen percent were between 26-40 years. Only 9% were less than 25 years old with 4% of the respondents did not respond or comment on this question, as shown in table 6-3.

Table 6-3 shows also, the percentages of ages of respondent in each case study block. Four of the thirteen case study blocks were occupied mainly by elderly people only, those are Lapworth House, Wheeldon House, Essington House and Salisbury Tower. Three of them (except Lapworth House) are vertical warden schemes blocks.

TABLE 6-2

SEX STRUCTURE OF THE RESPONDENTS IN EACH BLOCK

No.	TOWER BLOCK NAMES	STOREYS No.	% MALE	% FEMALE	%NO RESPONSE
1.	LAPWORTH HO.	13	37.5	62.5	-
2.	DURHAM TOWER	20	60.0	40.0	-
3.	STOKESAY HO.	11	35.3	64.7	-
4.	NETLEY HOUSE	11	40.0	55.0	5.0
5.	WHEELDON HO.	11	31.0	69.0	-
6.	WESTON HOUSE	13	33.3	66.7	-
7.	WOBURN HOUSE	13	25.0	75.0	-
8.	BALDWIN HO.	15	37.5	37.5	25.0
9.	ESSINGTON HO.	15	47.1	50.0	2.9
10	DORSET TOWER	18	40.0	50.0	10.0
11	NORMANSEL TO.	18	39.3	53.6	7.1
12	SALISBURY TO.	20	30.8	69.2	-
13	BARRY JACKSON	20	50.0	46.4	3.6
Total Respondents (268)			40.0	56.0	4.0

TABLE 6-3:
PERCENTAGES OF AGE OF RESPONDENTS IN EACH BLOCK

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS)	18-25 YEARS	26-40 YEARS	41-64 YEARS	65 YEARS OR OVER	%NO RESPONSE
1.	LAPWORTH HO.	13	18	-	12.5	75.0	12.5	-
2.	DURHAM TOWER	20	17	10.0	20.0	40.0	30.0	-
3.	STOKESAY HO.	11	22	17.6	11.8	17.6	52.9	-
4.	NETLEY HOUSE	11	22	25.0	10.0	10.0	50.0	5.0
5.	WHEELDON HO.	11	16	-	-	27.6	72.4	-
6.	WESTON HOUSE	13	20	22.2	22.2	33.3	22.2	-
7.	WOBURN HOUSE	13	17	8.3	16.7	16.7	58.3	-
8.	BALDWIN HO.	15	19	-	-	25.0	50.0	-
9.	ESSINGTON HO.	15	18	-	2.9	23.5	70.6	2.9
10	DORSET TOWER	18	16	10.0	40.0	20.0	20.0	10.0
11	NORMANSEL TO.	18	15	32.1	25.0	17.9	17.9	7.1
12	SALISBURY TO.	20	19	-	-	15.4	84.6	-
13	BARRY JACKSON	20	15	3.6	39.3	28.6	25.0	3.6
Total Respondents (268)				9.0	15.0	24.0	48.0	4.0

The remaining nine blocks comprise a mixture of ages. Two blocks have high proportions of younger residents (18-25 years), namely: Netley House and Normansell Tower.

4. Marital Status:

Approximately one-fourth of the total residents in the thirteen case study blocks (268) were married couples (26%). Slightly more than one third of the total residents were single persons living alone (34%). The majority of other status were widows and only 4% of the respondents did not report their marital status, as shown in table 6-4.

Table 6-4 shows the marital status of the respondents in each case study block and the totals for the thirteen blocks. The largest number of single people were found in Barry Jackson Tower (61%) and in Dorset Tower (55%). While the largest number of married couples was found in Netley House (40%). Other marital status such as widows, divorcees and etc. were found in high proportions in the other ten blocks (range between 42% to 63%), as shown in table 6-4. In summary, all the case study blocks comprise a mix of the all marital status, but at differing percentage rates.

5. Occupation:

Occupations of the respondents were classified into five categories as shown in table 6-5, namely: Employed, unemployed, retired, housewife and other (including no comment). The predominant occupational category for the total responses (268) was retired (43%). Employed and unemployed occupation categories were similar (19% and 18% respectively). Only 6% of the respondents were housewives and the rest 14% were other categories such as disabled, student, etc. and included without response.

TABLE 6-4

MARITAL STATUS OF THE RESPONDENTS IN EACH BLOCK

No.	TOWER BLOCK NAMES	STOREYS No.	% SINGLE	% MARRIED	% OTHERS	%NO RESPONSE
1.	LAPWORTH HO.	13	12.5	25.0	62.5	-
2.	DURHAM TOWER	20	20.0	30.0	50.0	-
3.	STOKESAY HO.	11	23.5	29.4	47.1	-
4.	NETLEY HOUSE	11	25.0	40.0	30.0	5.0
5.	WHEELDON HO.	11	17.2	31.0	51.7	-
6.	WESTON HOUSE	13	33.3	22.2	44.4	-
7.	WOBURN HOUSE	13	41.7	16.7	41.7	-
8.	BALDWIN HO.	15	18.8	18.8	37.5	25.0
9.	ESSINGTON HO.	15	29.4	32.4	32.4	5.9
10	DORSET TOWER	18	55.0	15.0	20.0	10.0
11	NORMANSEL TO.	18	57.1	14.3	21.4	7.1
12	SALISBURY TO.	20	23.1	23.1	53.8	-
13	BARRY JACKSON	20	60.7	32.1	7.1	-
	Total Respondents (268)		34.0	26.0	36.0	4.0

TABLE 6-5:

PERCENTAGES OF RESPONDENTS IN EACH OCCUPATION FOR EACH BLOCK

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	% EMPLOYED	%UNEMPLOYED	% RETAIRED	% HOUSEWIFE	%OTHER & NO COMMENT
1.	LAPWORTH HO.	13	19	25.0	25.0	37.5	-	12.5
2.	DURHAM TOWER	20	18	30.0	30.0	30.0	-	10.0
3.	STOKESAY HO.	11	23	5.9	29.4	23.5	17.6	23.5
4.	NETLEY HOUSE	11	23	35.0	-	35.0	5.0	25.0
5.	WHEELDON HO.	11	17	17.2	3.4	65.5	10.3	3.4
6.	WESTON HOUSE	13	21	22.2	22.2	44.4	-	11.1
7.	WOBURN HOUSE	13	18	8.3	16.7	41.7	8.3	25.0
8.	BALDWIN HO.	15	20	6.3	-	50.0	-	47.8
9.	ESSINGTON HO.	15	19	23.5	5.9	58.8	-	11.8
10	DORSET TOWER	18	17	40.0	20.0	30.0	-	10.0
11	NORMANSEL TO.	18	16	21.4	35.7	17.9	10.7	14.3
12	SALISBURY TO.	20	20	3.8	19.2	69.2	7.7	-
13	BARRY JACKSON	20	16	21.4	39.3	28.6	3.6	7.2
Total Respondents (268)				19.0	18.0	43.0	6.0	14.0

Table 6-5 shows the percentage of responses in each occupation category, for each case study block and the total for the thirteen blocks. The highest rate for the employed category was 40% in Dorset Tower. While the highest number of unemployed respondents were in Barry Jackson (39.3%) and in Normansell Towers (35.7). There were no unemployed respondents in Netley House and Baldwin House. The number of retired persons in this sort of building is relatively high, and in many of the case studies amounts to more than 50%, specifically Wheeldon House (65.5%), Baldwin House (50%), Essington House (58.8) and Salisbury Tower (69.2%). Three of these are vertical warden schemes. The housewife response was obtained from only half of the case study blocks and then at low percentage rates.

6. Size of Household:

This means the number of people in each dwelling. Of the total 268 responses in the thirteen case study blocks, a large number (48%) were single residents. Only 27% of the respondents were couples. A very limited number of total responses were families with children (only 5%).

The average occupancy rate (number of persons) per dwelling in the thirteen case study block was 1.47. This means that many of the blocks are under-occupied compared to their design capacity and it is very low in term of density and cost sense for this type of building.

7. Children Living in Dwellings:

A high incidence (95%) of the total respondents (268) had no children under 16 years of age living in the dwellings of the case study blocks. This is due to the policy of the Birmingham City, whereby high-rise dwellings are no longer let to families with children. However, 5% of the respondents had at least one child under the age of 16 years living in the same dwelling. Only one respondent has three children living in the same dwelling.

8. Length of Dwelling Occupancy:

The length of dwelling occupancy ranged from less than one year to 23 years. The mean length of occupancy for the total responses (268) was 10.45 years. Around 10% of the total respondents had lived in the dwellings for less than a year, nearly 20% of total respondents for one to five years and approximately one-fourth of the respondents had lived in the dwellings for five to ten years. The remaining respondents, especially the elderly people, had lived in their dwellings since the beginning of building occupation (range between 16 to 23 years).

6.2 Residents' Satisfaction and Attitude toward the dwellings

The dwelling component in the social appraisal questionnaire comprises five items; living room, bed room(s), kitchen, bathroom & W.C. and the dwelling in general, as shown in Appendix (VII). Each of these items contains many questions (as sub-items). These questions are either positively stated or negatively stated (very limited). Each positive statement was scored from one (strongly disagree) to five (strongly agree), each negative statement was reverse scored. The higher the score, the more positive the satisfaction and attitude. In the other words the residents' satisfaction and attitude toward the dwelling and the multi-storey dwelling blocks was measured on a five points Likert scale.

In the analysis, the frequency distribution of each statement in Likert scale for each sub-item was calculated. Then, the frequency distribution of the statements for each of the items was calculated by the summation of the relating sub-items. For instance, the frequency distribution for each statement of the six questions (sub-items) for the living room were added together to give the final frequency distribution results for the living room item itself. In more detail by way of example, the living room in Normansell Tower is shown in table 6-6:

An attempt was made to devise a method of estimating overall satisfaction with each item of the dwelling and the dwelling in general. Where, each statement was converted in terms of satisfaction as follows: "strongly agree" indicates "very satisfied", "agree" means "satisfied", "Uncertain" is "in between", "disagree" means "Dissatisfied" and "strongly disagree" means "strongly dissatisfied".

Living Room

Quest. No.	S. Agree	Agree	Uncertain	Disagree	S. Disagree	No comment
211*	-	15	6	7	-	-
212*	1	16	2	9	-	0
213*	3	19	2	1	3	-
214*	3	19	3	2	1	-
215*	1	8	6	6	7	-
216*	-	7	3	9	9	-
Living room	8	84	22	34	20	-
(in General)	4.8%	50%	13.1%	20.2%	11.9%	0%

*Note:- See Appendix (VII) for the subject of the questions.

Table 6-6 The frequency distribution of each statement in "living room" category For Normansell Tower.

The frequency distribution of each satisfaction statement was converted into percentage rates and the results of the "very satisfied" and "satisfied" were combined to give more clarity and understanding to the results. Also, "strongly dissatisfied" and "dissatisfied" were combined for the same reasons to represent dissatisfaction. The "Uncertain" means that the level of satisfaction is in between. For the five scale results for each of the dwelling categories and for the dwelling in general, see Appendix (VIII).

So, the index of satisfaction for each of the thirteen case study blocks and for all of them were described in terms of each item of the dwelling and according to the list of the social appraisal questionnaire:

1. Living Room:

The social appraisal questionnaire asked six questions about the living room, as shown in Appendix (VII). The level of satisfaction with the living room in the thirteen case study blocks is shown in table 6-7.

Table 6-7 shows that the lowest percentages of satisfaction with the living room were at Weston House (53.7%) and Normansell Tower (54.8%), but there no one was actually strongly dissatisfied. The blocks with the highest percentage in the dissatisfied category were again Normansell Tower and then Weston House. The dissatisfaction in the rest of case studies was around 25% or less. It would appear that the highest level of satisfaction with the living room was at Wheeldon House (85.6%). While the level of satisfaction at the rest of the study blocks was, in general, more than 60%.

For all the blocks, the attitude toward the living room is good in general, where the level of satisfaction with the living room was 68.7%. These results depend mainly on the feeling of the residents toward the problems of arranging and fitting furniture, the size and physical layout of living room, in addition to the problems of heating and noise insulation and ventilation facility in the living room. The main causes of dissatisfaction with the living room were the noise and difficulty and cost of keeping it warm.

TABLE 6-7:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR LIVING ROOM.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	SATISFIED	IN BETWEEN	DISSATISFIED	%NO RESPONSE
1.	LAPWORTH HO.	13	19	66.6	12.5	20.9	-
2.	DURHAM TOWER	20	18	78.3	5.0	16.7	-
3.	STOKESAY HO.	11	23	62.8	11.8	25.4	-
4.	NETLEY HOUSE	11	23	75.0	5.8	19.1	-
5.	WHEELDON HO.	11	17	85.6	3.4	10.9	-
6.	WESTON HOUSE	13	21	53.7	16.7	29.6	-
7.	WOBURN HOUSE	13	18	65.3	15.3	19.4	-
8.	BALDWIN HO.	15	20	62.5	16.7	20.8	-
9.	ESSINGTON HO.	15	19	76.0	6.9	16.2	1.0
10	DORSET TOWER	18	17	60.9	15.0	24.2	-
11	NORMANSEL TO.	18	16	54.8	13.1	32.1	-
12	SALISBURY TO.	20	20	76.3	9.0	14.8	-
13	BARRY JACKSON	20	16	61.9	15.5	18.4	4.2
Total Respondents (268)				68.7	10.4	22.1	0.8

2. Bedroom(s):

The social appraisal questionnaire asked five questions about the bedroom(s), as shown in Appendix (VII). The level of satisfaction with the bedroom(s) in the thirteen case study blocks is shown in table 6-8.

Table 6-8 shows that the lowest percentages who were satisfied with the bedroom(s) was at Dorest Tower (52.0%). The blocks with the highest percentage in the dissatisfied category were Stokesay House (31.8%) and then Woburn House (30.0%). The dissatisfactions in the rest of case studies were around 28% and less. The results show that the highest level of satisfaction with the bedroom(s) was at Wheeldon House (82.8%). While the level of satisfaction for the rest of the study blocks was, in general, more than 53%.

For all the blocks collectively, the attitude toward the bedroom(s) was good, where the level of satisfaction with the bedroom(s) was 68.1%. This was dependent mainly on the feeling of the residents toward the problems of arranging and fitting furniture, the size and the physical layout of bedroom(s), in addition to the availability of heating, sound insulation and storage facility in the Bedroom(s). The main dissatisfaction points were the noise and storage space.

3. Kitchen:

The social appraisal questionnaire asked six questions about the kitchen, as shown in Appendix (VII). The level of satisfaction with the kitchen in the thirteen case study blocks is shown in table 6-9.

Table 6-9 shows that the lowest percentage who were satisfied with the kitchen was at Dorset Tower (44.1%). The blocks with the highest percentage in the dissatisfied category were Stokesay House (39.2%) and then Dorset Tower (34.2%).

TABLE 6-8:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR BEDROOM(S).

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	SATISFIED	IN BETWEEN	DISSATISFIED	%NO RESPONSE
1.	LAPWORTH HO.	13	19	62.5	12.5	25.0	-
2.	DURHAM TOWER	20	18	70.0	2.0	28.0	-
3.	STOKESAY HO.	11	23	56.4	11.8	31.8	-
4.	NETLEY HOUSE	11	23	79.0	2.0	19.0	-
5.	WHEELDON HO.	11	17	82.8	4.1	13.1	-
6.	WESTON HOUSE	13	21	53.3	20.0	26.7	-
7.	WOBURN HOUSE	13	18	58.3	11.7	30.0	-
8.	BALDWIN HO.	15	20	65.0	13.7	21.3	-
9.	ESSINGTON HO.	15	19	73.5	8.2	17.6	0.6
10	DORSET TOWER	18	17	52.0	22.0	26.0	-
11	NORMANSEL TO.	18	16	61.5	7.9	30.7	-
12	SALISBURY TO.	20	20	78.5	4.6	16.9	-
13	BARRY JACKSON	20	16	63.6	17.9	15.0	3.5
Total Respondents (268)				68.1	9.6	21.8	0.5

TABLE 6-9:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR KITCHEN.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	SATISFIED	IN BETWEEN	DISSATISFIED	%NO RESPONSE
1.	LAPWORTH HO.	13	19	68.8	12.5	18.7	-
2.	DURHAM TOWER	20	18	85.0	1.7	13.3	-
3.	STOKESAY HO.	11	23	46.0	14.7	39.2	-
4.	NETLEY HOUSE	11	23	73.4	8.3	19.3	-
5.	WHEELDON HO.	11	17	80.4	8.1	11.5	-
6.	WESTON HOUSE	13	21	48.2	24.1	27.8	-
7.	WOBURN HOUSE	13	18	73.8	2.8	23.6	-
8.	BALDWIN HO.	15	20	76.1	3.1	20.8	-
9.	ESSINGTON HO.	15	19	89.7	2.0	8.3	-
10	DORSET TOWER	18	17	44.1	21.7	34.2	-
11	NORMANSEL TO.	18	16	67.8	6.5	25.6	-
12	SALISBURY TO.	20	20	71.2	7.1	21.8	-
13	BARRY JACKSON	20	16	69.6	12.5	14.3	3.6
Total Respondents (268)				74.9	8.1	16.6	0.5

The dissatisfactions in the rest of case studies were around 27% and less. It would appear that the highest level of satisfaction with the kitchen was at Essington House (89.7%). While the level of satisfaction at the rest of the study blocks ranges between 46% and 85%.

For most of the blocks, the attitude toward the Kitchen, was generally very good, except for Stokesay House, Weston House and Dorset Tower, where the attitude was in-between. The total level of satisfaction with the kitchen was 74.9%, 16% being strongly satisfied. This was dependent mainly on the feeling of the residents toward the problems of arranging and fitting furniture and appliances, the size and the physical layout of the kitchen, in addition to storage facilities in the kitchen and the kitchen units used. The main dissatisfaction category was the adequacy of the means of preventing cooking smells reaching other part of the dwelling.

4. Bathroom & W.C.:

The social appraisal questionnaire asked five questions about the bathroom & W.C., as shown in Appendix (VII). The level of satisfaction with the bathroom & W.C. in the thirteen case study blocks is shown in table 6-10.

Table 6-10 shows that the lowest percentage who were satisfied with the bathroom & W.C. was at Stokesay House (44.7%). The blocks with the highest percentage in the dissatisfied category were Stokesay House (34.1%) and then Normansell Tower (32.1%). The dissatisfactions in the rest of the case studies were around 30% or less. Results show that the highest level of satisfaction with the bathroom & W.C. was at Essington House (85.3%). While the level of satisfaction at the rest of the study blocks ranges between 52% and 81%.

TABLE 6-10:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR BATHROOM AND W.C..

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	SATISFIED	IN BETWEEN	DISSATISFIED	%NO RESPONSE
1.	LAPWORTH HO.	13	19	67.5	15.0	17.5	-
2.	DURHAM TOWER	20	18	70.0	2.0	28.0	-
3.	STOKESAY HO.	11	23	44.7	21.2	34.1	-
4.	NETLEY HOUSE	11	23	81.0	4.0	15.0	-
5.	WHEELDON HO.	11	17	75.2	6.2	18.6	-
6.	WESTON HOUSE	13	21	66.6	20.0	13.2	-
7.	WOBURN HOUSE	13	18	60.0	10.0	30.0	-
8.	BALDWIN HO.	15	20	71.2	6.2	22.6	-
9.	ESSINGTON HO.	15	19	85.3	5.3	9.4	-
10	DORSET TOWER	18	17	52.0	22.0	26.0	-
11	NORMANSEL TO.	18	16	60.0	7.9	32.1	-
12	SALISBURY TO.	20	20	75.4	9.2	15.3	-
13	BARRY JACKSON	20	16	69.3	15.0	6.4	9.3
Total Respondents (268)				70.0	9.4	20.1	0.5

For most of the blocks, the attitude toward the bathroom & W.C., were generally quite good, with the exception some blocks where the attitude to them was in-between; such as Stokesay House and Dorset Tower. The total level of satisfaction with the bathroom & W.C. was 70.0%. This was depending mainly on the feeling of the residents toward the adequacy, the size and physical layout of the bathroom & W.C., in addition to ventilation facilities in the bathroom & W.C. and their fittings. The main dissatisfaction point was the position of the bathroom & W.C..

5. The dwelling (in general):

The social appraisal questionnaire asked six questions about the dwelling (in general), as shown in Appendix (VII). The level of satisfaction with the dwelling depends mainly on these six questions in combination with the other twenty two questions relating to the above dwelling categories (i.e. living room, bedroom(s), kitchen and bathroom). The results of these combinations for the thirteen case study blocks is shown in table 6-11.

Table 6-11 shows that the lowest percentage who were satisfied with the dwelling was at Stokesay House (49.6%). The blocks with the highest percentage in the dissatisfied category were Normansell Tower (35.3%) and then Stokesay House (31.5%). Dissatisfaction in the rest of case studies was around 27% or less. The results show that the highest level of satisfaction with the dwelling was at Wheeldon House (80.3%). While the level of satisfaction for the rest of the study blocks ranges between 53% and 79%.

For most of the blocks, the attitude toward the dwelling in general, was good, except some blocks where the attitude at them were in-between, namely: Stokesay House, Weston House, Dorset Tower and Normansell Tower. This depends mainly on

TABLE 6-11:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR THE DWELLING (IN GENERAL).

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	SATISFIED	IN BETWEEN	DISSATISFIED	%NO RESPONSE
1.	LAPWORTH HO.	13	19	65.6	13.8	20.1	0.5
2.	DURHAM TOWER	20	18	68.6	3.9	27.5	-
3.	STOKESAY HO.	11	23	49.6	18.9	31.5	-
4.	NETLEY HOUSE	11	23	73.6	6.6	19.8	-
5.	WHEELDON HO.	11	17	80.3	7.9	11.9	-
6.	WESTON HOUSE	13	21	56.0	19.5	24.6	-
7.	WOBURN HOUSE	13	18	60.4	11.6	27.4	0.6
8.	BALDWIN HO.	15	20	64.1	12.5	23.5	-
9.	ESSINGTON HO.	15	19	79.0	6.7	13.3	1.1
10	DORSET TOWER	18	17	53.2	21.3	25.6	-
11	NORMANSEL TO.	18	16	54.2	10.5	35.3	-
12	SALISBURY TO.	20	20	72.8	9.5	17.7	-
13	BARRY JACKSON	20	16	61.9	17.5	16.9	3.7
Total Respondents (268)				66.9	11.2	21.2	0.6

the feeling of the residents toward the adequacy, the size and the physical layout of the dwelling (in general), in addition to other factors, which are mentioned above. 66.9% of the respondents were satisfied with the dwellings in general and only 21.2% were dissatisfied.

There was no complaint about the physical layout of the dwellings, 81% of the total respondents were "agree" and "strongly agree" that it is good. Also, the location of the dwelling within the building was good for most of the respondents, 77% of the total were satisfied. The main disagreement (38% of the total respondents) answers were with the question which is; there are no problems living in this particular dwelling.

Another question about the dwelling put to the residents was: " If I had to move away from this dwelling, I would be glad", see question 254 in Appendix (VII). Table 6-12 shows the percentages of respondents who were satisfied and glad to stay in their dwellings and those who were not satisfied and wanted to move away from their dwellings. These results give the real attitude of the respondents toward their dwellings, block and estate.

Table 6-12 shows that the lowest percentages who were satisfied and glad to stay in the same dwellings was at Stokesay House (11.8%). The blocks with the highest percentage in the dissatisfied category were Normansell Tower (71.4%) and then Durham Tower (60.0%). Dissatisfaction in the rest of case studies was around 37% and less. Results show that the highest level of satisfaction with the dwelling was at Wheeldon House (89.7%). While the level of satisfaction at the rest of the study blocks ranges between 14% and 58%. Of the total 268 respondents, 38.4 % were glad to stay in the same dwelling, while 30.8% were glad to move away from the dwelling. 28.9% were in between.

TABLE 6-12:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR LIVING IN THE DWELLING (QUEST. 254).

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	SATISFIED	IN BETWEEN	DISSATISFIED	%NO RESPONSE
1.	LAPWORTH HO.	13	19	37.5	12.5	37.5	12.5
2.	DURHAM TOWER	20	18	20.0	20.0	60.0	-
3.	STOKESAY HO.	11	23	11.8	58.8	29.4	-
4.	NETLEY HOUSE	11	23	40.0	30.0	30.0	-
5.	WHEELDON HO.	11	17	89.7	6.9	3.4	-
6.	WESTON HOUSE	13	21	22.2	33.3	44.4	-
7.	WOBURN HOUSE	13	18	41.6	25.0	33.3	-
8.	BALDWIN HO.	15	20	18.8	50.0	31.3	-
9.	ESSINGTON HO.	15	19	58.8	20.6	14.7	5.9
10	DORSET TOWER	18	17	40.0	40.0	20.0	-
11	NORMANSEL TO.	18	16	14.3	14.3	71.4	-
12	SALISBURY TO.	20	20	50.0	30.8	19.2	-
13	BARRY JACKSON	20	16	21.5	53.6	21.4	3.6
Total Respondents (268)				38.4	28.9	30.8	1.9

For the five scale results for each dwelling categories and for the dwelling in general (i.e. table 6-7 to table 6-12), see Appendix (VIII).

6.3 Residents' Satisfaction and Attitude toward the block

The block component in the social appraisal questionnaire comprises five items; the dwelling, finishes, services, environmental and the block in general, as shown in Appendix (VII). Each of these items contains many questions (as sub-items). These questions are either positively stated or negatively stated (very limited). Each positive statement was scored from one (strongly disagree) to five (strongly agree), each negative statement was reverse scored. The higher the score, the more positive the satisfaction and attitude. In the other words the residents' satisfaction and attitude toward the multi-storey dwelling blocks was measured on a five points Likert scale.

In the analysis, similar to the dwelling satisfaction measurement, the frequency distribution of each statement in Likert scale for each sub-item was calculated. Then, the frequency distribution of the statements for each item was calculated by the summation of the relating sub-items. For instance, see table 6-6:

As in dwelling satisfaction measurement, an attempt was made to devise a method of estimating overall satisfaction for each item of the block and the block in general. Where, each statement was converted in terms of satisfaction as follows: "strongly agree" indicates "very satisfied", "agree" means "satisfied", "Uncertain" is "in between", "disagree" means "Dissatisfied" and "strongly disagree" means "strongly dissatisfied".

The frequency distribution of each satisfaction statement was converted into percentage rates and the results of the "very satisfied" and "satisfied" were combined to give more clarity and understanding to the results. Also, "strongly dissatisfied" and "dissatisfied" were combined for the same reasons to represent the dissatisfaction. "Uncertain" means that the level of satisfaction was in between. For the five scale results for each block categories and for the block in general, see Appendix (VIII).

So, the index of satisfaction for each of the thirteen case study blocks and collectively was described in terms of each item of the block and according to the list of the social appraisal questionnaire:

1. Finishes:

The social appraisal questionnaire asked nine questions about the finishes, as shown in Appendix (VII). The level of satisfaction with the finishes in the thirteen case study blocks is shown in table 6-13.

Table 6-13 shows that the lowest percentages who were satisfied with the finishes was at Normansell Tower (21.8%). The blocks with the highest percentage in the dissatisfied category were Durham Tower (55.6%) and then Woburn House (53.7%), and there are two other blocks with a level of dissatisfaction greater than 50% (Stokesay House and Normansell Tower). Dissatisfaction in the rest of case studies was around 32% and less. results show that the highest level of satisfaction with the finishes was for Wheeldon House (87.3%). While the level of satisfaction for the rest of the study blocks, in general, ranged between 28% to 80%.

TABLE 6-13:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR FINISHES.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	SATISFIED	IN BETWEEN	DISSATISFIED	%NO RESPONSE
1.	LAPWORTH HO.	13	19	48.6	25.0	26.4	-
2.	DURHAM TOWER	20	18	35.6	7.8	55.6	1.1
3.	STOKESAY HO.	11	23	28.1	20.2	50.3	1.3
4.	NETLEY HOUSE	11	23	69.5	11.1	19.4	-
5.	WHEELDON HO.	11	17	87.3	5.4	7.3	-
6.	WESTON HOUSE	13	21	54.3	22.2	22.2	1.2
7.	WOBURN HOUSE	13	18	28.7	17.6	53.7	-
8.	BALDWIN HO.	15	20	36.8	18.8	44.4	-
9.	ESSINGTON HO.	15	19	79.1	7.2	11.5	2.3
10	DORSET TOWER	18	17	49.4	26.7	23.9	-
11	NORMANSEL TO.	18	16	21.8	26.6	51.2	0.4
12	SALISBURY TO.	20	20	62.4	12.8	24.8	-
13	BARRY JACKSON	20	16	41.2	22.6	32.6	3.6
Total Respondents (268)				52.3	15.8	30.9	1.1

For all the blocks, the attitudes toward the finishes, in general, was "in between". As shown in table 6-13, the level of satisfaction with the finishes in the study blocks collectively was 52.3%, while the dissatisfaction level was 30.9%. This was dependent mainly on the feelings of the residents toward the condition of the finish items in each block such as the external cladding, the plaster, the doors and windows, the internal fixtures, the condition of the refuse chute-room, the communal areas, the security system and so on. In general, the main dissatisfaction categories in the finishes were the physical condition of the external cladding, main entrance doors, communal areas and the security systems in some study blocks.

2. Services:

The social appraisal questionnaire asked nine questions about the services items in multi-storey dwelling blocks, as shown in Appendix (VII). The level of satisfaction and attitude with the services in the thirteen case study blocks is shown in table 6-14.

Table 6-14 shows that the lowest percentages who were satisfied with the services was at Dorset Tower (38.4%). The blocks with the highest percentage in the dissatisfied category were Stokesay House (38.9%) and then Normansell Tower (36.5%). Dissatisfaction in the rest of case studies was around 35% or less. Results show that the highest level of satisfaction with the services was at Essington House (79.1%). While the level of satisfaction for the rest of the study blocks ranged between 41% to 73%.

For all the blocks, the attitude toward the services in the multi-storey dwelling blocks, in general, was "in-between". As shown in table 6-14, the level of satisfaction with the services in the total study blocks was 56.9% and the dissatisfaction was 28.4%. This depends mainly on the feeling of the residents toward

TABLE 6-14:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR SERVICES.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	SATISFIED	IN BETWEEN	DISSATISFIED	%NO RESPONSE
1.	LAPWORTH HO.	13	19	43.8	21.9	34.4	-
2.	DURHAM TOWER	20	18	63.3	6.7	28.9	1.1
3.	STOKESAY HO.	11	23	43.4	17.6	38.9	-
4.	NETLEY HOUSE	11	23	71.3	10.0	18.8	-
5.	WHEELDON HO.	11	17	73.2	4.6	22.2	-
6.	WESTON HOUSE	13	21	68.1	13.9	18.0	-
7.	WOBURN HOUSE	13	18	47.3	14.8	33.3	4.6
8.	BALDWIN HO.	15	20	58.6	10.2	30.5	0.8
9.	ESSINGTON HO.	15	19	79.1	3.7	16.2	1.1
10	DORSET TOWER	18	17	38.4	23.9	35.6	2.2
11	NORMANSEL TO.	18	16	41.3	21.8	36.5	0.4
12	SALISBURY TO.	20	20	69.8	10.1	20.2	-
13	BARRY JACKSON	20	16	47.2	26.9	26.9	-
Total Respondents (268)				56.9	14.2	28.4	0.4

the condition of the service items in each block such as the central heating system used, water supply system, plumbing and drainage systems, switches and power points, the lift(s), ventilation systems, noise, gas supply and so on. The main cause of dissatisfaction in the services category were the central heating systems and external and internal noise.

3. Environment:

The social appraisal questionnaire asked nine questions about the environmental items in multi-storey dwelling blocks, as shown in Appendix (VII). The level of satisfaction with the environmental items in the thirteen case study blocks is shown in table 6-15.

Table 6-15 shows that the lowest percentage who were satisfied with the environment was at Woburn House (34.3%). The blocks with the highest percentage in the dissatisfied category were Woburn House (50.9%) and then Durham Tower (41.0%). Dissatisfaction in the rest of case studies was around 38% or less. Results show that the highest level of satisfaction with the environment was at Essington House (76.1%). While the level of satisfaction for the rest of the study blocks ranged between 44% to 72%.

For all the blocks, the attitudes toward the environment in the multi-storey dwelling blocks, in general, was "in between". As shown in table 6-15, the level of satisfaction with the environment in the study blocks collectively was 56.7% and the dissatisfaction was 24.5%. This was dependent mainly on the feeling of the residents toward the condition of the environmental items surrounding each block such as public services, the landscaped areas, the paved areas, parking facilities, childrens' play areas, shopping and health facilities around the block and so on. The main

TABLE 6-15:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR ENVIRONMENT.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	SATISFIED	IN BETWEEN	DISSATISFIED	%NO RESPONSE
1.	LAPWORTH HO.	13	19	59.7	20.8	19.4	-
2.	DURHAM TOWER	20	18	47.8	10.0	41.0	1.1
3.	STOKESAY HO.	11	23	45.1	30.1	24.8	-
4.	NETLEY HOUSE	11	23	71.1	15.6	13.3	-
5.	WHEELDON HO.	11	17	70.1	10.1	20.0	-
6.	WESTON HOUSE	13	21	51.9	29.6	18.5	-
7.	WOBURN HOUSE	13	18	34.3	13.0	50.9	1.9
8.	BALDWIN HO.	15	20	54.9	15.3	28.5	1.4
9.	ESSINGTON HO.	15	19	76.1	12.1	7.1	4.6
10	DORSET TOWER	18	17	50.0	24.4	25.0	0.6
11	NORMANSEL TO.	18	16	44.5	17.1	38.1	0.4
12	SALISBURY TO.	20	20	48.3	28.6	23.0	-
13	BARRY JACKSON	20	16	42.9	29.4	27.7	-
Total Respondents (268)				56.7	17.7	24.5	1.1

dissatisfaction categories with the environment were the children play facilities and the problems caused by children outside the blocks.

4. The block (in general):

The social appraisal questionnaire asked eight questions about the block (in general), as shown in Appendix (VII). The level of satisfaction with the block depends mainly on these eight questions in combination with the other twenty seven questions relating to the above block categories (i.e. finishes, services and environment) and twenty eight questions relating to the dwelling categories. The results of the combination of these sixty three questions for each of the thirteen case study blocks give the final satisfaction results for the blocks, as shown in table 6-16.

Table 6-16 shows that the lowest percentage who were satisfied with the block was at Normansell Tower (35.2%). The blocks with the highest percentage in the dissatisfied category were Woburn House (45.7%) and then Durham Tower (44.2%). Dissatisfaction in the rest of case studies was around 37% or less. Results show that the highest level of satisfaction with the block was at Wheeldon House (79.4%). While the level of satisfaction for the rest of the study blocks ranged between 35% and 78%.

For nearly half of the study blocks, the attitude toward the block, in general, was good, except some blocks where the attitude to them was "in-between", namely: Durham Tower, Stokesay House, Woburn House, Baldwin House, Dorset Tower, Normansell Tower and Barry Jackson Tower. The level of satisfaction with the block for the study blocks collectively was 54.8% and the dissatisfaction was only 27.7%. This was dependent mainly on the feeling of the residents toward the adequacy, the

TABLE 6-16:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR THE BLOCK (IN GENERAL).

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	SATISFIED	IN BETWEEN	DISSATISFIED	%NO RESPONSE
1.	LAPWORTH HO.	13	19	52.2	22.1	25.7	-
2.	DURHAM TOWER	20	18	46.9	8.0	44.2	0.9
3.	STOKESAY HO.	11	23	38.4	24.2	37.1	0.3
4.	NETLEY HOUSE	11	23	69.0	14.1	16.9	-
5.	WHEELDON HO.	11	17	79.4	6.8	13.8	-
6.	WESTON HOUSE	13	21	55.2	22.2	21.6	1.0
7.	WOBURN HOUSE	13	18	35.9	16.4	45.7	1.9
8.	BALDWIN HO.	15	20	47.6	15.6	36.1	0.7
9.	ESSINGTON HO.	15	19	77.8	8.8	10.9	2.5
10	DORSET TOWER	18	17	44.9	27.6	26.8	0.7
11	NORMANSEL TO.	18	16	35.2	21.4	43.1	0.3
12	SALISBURY TO.	20	20	59.9	17.6	22.6	-
13	BARRY JACKSON	20	16	39.9	28.5	30.6	1.0
Total Respondents (268)				54.8	16.9	27.7	0.7

main components and the physical layout of the block (in general), in addition to other factors, which are mentioned above.

The main dissatisfaction categories were about the safety and the vandalism on the blocks, where more than half (52%) of the total respondents feel unsafe walking around different parts of the building at night (in some blocks, a lot of respondents added even at the day). About the same percentage rate of the total respondents complained from the vandalism in and around their blocks.

Another dissatisfaction category was the physical layout of the block, where nearly half of the total respondents (45%) agreed that it is generally poor and only 23% of them disagreed. The privacy was another point of complaint within the blocks, where half of the total respondents agreed that there is no privacy in living within this sort of dwelling block, while only 25% disagreed.

5. The estate:

The social appraisal questionnaire asked several questions about the estate. The most important of these deals directly with satisfaction with the estate in general {question 346, see Appendix (VII)}. Amongst the total 268 respondents, the level of satisfaction was 64.3%, 11% of these were strongly satisfied. 20% of the total respondents were dissatisfied with living in the estate.

The levels of satisfaction results for the estate for each of the thirteen case study blocks are shown in figure 6-1 in ascending order. The lowest percentage who were satisfied with the estate was at Durham Tower (30.0%). The blocks with the highest level of satisfaction were Wheeldon House (96.6%) and then Essington House

(88.2%). The level of satisfaction for the rest of the study blocks ranged between 42.9% and 80.0%.

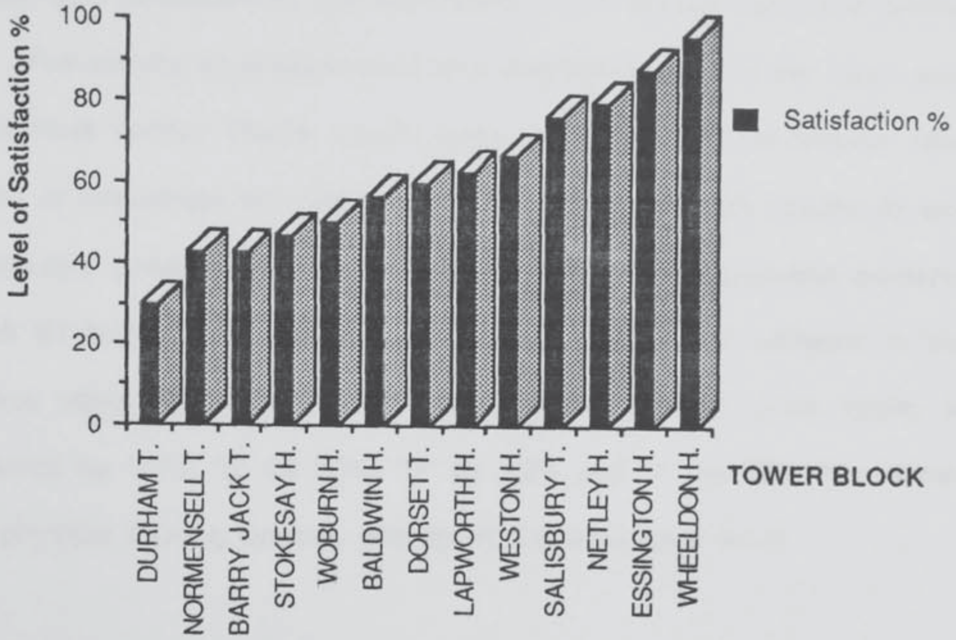


Figure 6-1 The level of satisfaction with the estate of the thirteen study blocks.

This depends mainly on the availability of the shopping, health, parking and transportation facilities, in addition to the other social factors such as the safety, the neighbours, the security and so on.

Good transport, reasonably easy shopping, access to doctors and a feeling of security were very important to the residents. These main factors largely determined whether they found their estate satisfactory or not. Another factor which affected many residents level of satisfaction with their estate, was the availability of recreational and communal facilities.

6.4 Blocks-ranking:

The social appraisal scoring system used in this study depends mainly on the mean value of the statements in Likert scale for each sub-item. The mean value for each item was calculated by the summation of the relating sub-items divided by their number. The results were between 5 (the maximum score in the Likert scale) and 1 (the minimum score). These results were converted into percentage rates for the purposes of integration with the physical appraisal approach results, to arrive at the final appraisal results. In this conversion, the "5" scale represents percentage rates between 81-100%. The representative score (90%) was adopted in the scoring technique used. Similarly, for the other points of the Likert scale, where "4" represented by 70%, "3" by 50%, "2" by 30% and "1" by 10% (the same principle as the physical scoring system, see figure 4-3 in chapter four).

For instance, the mean satisfaction value for each sub-item (i.e. the six questions) for the living room were added together and then divided by six to give the mean satisfaction value for the living room item itself. This mean satisfaction value for the living room was converted into a percentage rate to give the social appraisal score for the living room. In more detail, the account of the social appraisal score for the living room in Normansell Tower is taken as an example, and is shown in table 6-17:

According to the social scoring system used in this study, the social appraisal scores for the four categories of each dwelling: living room, bedroom(s), kitchen and bathroom, in addition to the social score for the dwelling in general (which depends mainly on the satisfaction mean result for the 28 sub-items, see Appendix VII) of each study block were calculated as percentage rates, as shown in table 6-18.

Living Room

Quest. No.	The satisfaction mean
211*	3.286
212*	3.321
213*	3.643
214*	3.750
215*	2.714
216*	2.286

The summation = 19.00 The satisfaction mean of Living room= **3.167**
% Living room score = **53.3%** (where 3.167 ==> 50% + 0.167 * 20 = <u>53.3%</u>)

*Note:- See Appendix (VII) for the subject of the questions.

Table 6-17 The social appraisal score for the living room category on Normansell Tower block.

Table 6-18 shows the social appraisal scores for the dwelling range between 66.3% for Essington House (the highest score) and 52.0% for Stokesay House (the lowest score). In fact, each of these scores depends principally on the differences in the level of satisfaction and attitude of the residents toward the dwelling categories. This was affected by the biographical data of the respondents in each block. The percentage of the respondents who were satisfied with the dwelling at Essington House was 79.0% (the highest level of satisfaction) and the dissatisfaction percentage for this block was 13.3% only. While the level of satisfaction with the dwelling at the Stokesay House was the lowest (49.2%) and the dissatisfaction level was 31.5%. The social appraisal scores for the dwelling at the other 11 blocks ranged between 52.0% and 66.0%.

From these results, multiple regression analyses were done to examine the relationships between the social appraisal scores for the dwelling and dwelling categories, and the age and height of the blocks. The statistical results showed no

TABLE 6-18:

SOCIAL APPRAISAL SCORES (%) OF THE DWELLINGS AND THE DWELLING'S CATEGORIES FOR THE 13 CASE STUDY BLOCKS

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	LIVING ROOM	BEDROOM(S)	KITCHEN	BATH & W.C.	DWELLING (IN GENERAL)
1.	LAPWORTH HO.	13	19	57.9	56.0	58.3	59.5	57.9
2.	DURHAM HOUSE	20	18	63.0	59.2	67.7	58.4	58.4
3.	STOKESAY HO.	11	23	58.0	53.5	48.8	49.1	52.0
4.	NETLEY HOUSE	11	23	61.3	61.6	61.2	62.8	60.5
5.	WHEELDON HO.	11	17	65.9	65.7	65.8	63.0	65.4
6.	WESTON HOUSE	13	21	54.1	54.0	53.3	60.7	55.6
7.	WOBURN HOUSE	13	18	60.3	57.7	59.7	55.7	56.7
8.	BALDWIN HO.	15	20	58.3	56.8	60.6	60.3	57.6
9.	ESSINGTON HO.	15	19	64.8	62.4	70.1	69.1	66.3
10	DORSET TOWER	18	17	56.2	53.4	50.1	54.6	54.5
11	NORMANSEL TO.	18	16	53.1	55.4	58.2	55.4	52.2
12	SALISBURY TO.	20	20	63.6	64.0	60.3	64.5	61.8
13	BARRY JACKSON	20	16	59.8	61.3	62.0	62.6	59.7

significant correlations (all the significance level were more than 0.01) between the age, height of the blocks and the social appraisal scores for the dwelling and dwelling categories.

In the same way, the social appraisal scores for the finishes, services and environment items for each study block were calculated. In addition, the final social appraisal score for each study block was calculated. This final score depends on the mean values of the sixty three questions (sub-items) in the social appraisal questionnaire (see Appendix VII-parts two and three). Table 6-19 shows these social appraisal scores, including the dwelling scores, the height and age of each case study block.

As shown in table 6-19, the social appraisal scores for the block range between 66.2% for Essington House (the highest score) and 48.4% for Normansell Tower (the lowest score). Each of these scores is derived from the differences in the levels of satisfaction and attitudes of the residents toward the block in general and the block's categories. This was also affected by the biographical data on the respondents in each block (refer to table 6-16 to see these differences in the satisfaction level at the study blocks). The social appraisal scores for the other 11 blocks ranged between 49.0% and 65.0%.

From these results, multiple regression analyses were done to examine the relationships between the social appraisal scores for the block and block categories, and the age and height of the blocks. The statistical results showed no significant correlations (all the significance level were more than 0.45) between the age, height of the blocks and the social appraisal scores for the block and block categories.

TABLE 6-19:

SOCIAL APPRAISAL SCORES (%) OF THE BLOCK AND THE BLOCK'S CATEGORIES FOR THE 13 CASE STUDY BLOCKS

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	DWELLING (IN GENERAL)	FINISHES	SERVICES	ENVIRONMENT	BLOCKS (IN GENERAL)
1.	LAPWORTH HO.	13	19	57.9	50.8	48.2	56.4	55.0
2.	DURHAM HOUSE	20	18	58.4	38.9	56.5	48.9	52.3
3.	STOKESAY HO.	11	23	52.0	41.3	47.8	52.2	49.4
4.	NETLEY HOUSE	11	23	60.5	59.1	59.4	61.3	60.1
5.	WHEELDON HO.	11	17	65.4	67.5	59.6	61.5	64.9
6.	WESTON HOUSE	13	21	55.6	54.7	58.6	55.2	55.3
7.	WOBURN HOUSE	13	18	56.7	38.9	51.1	42.7	50.0
8.	BALDWIN HO.	15	20	57.6	47.4	55.6	54.3	54.1
9.	ESSINGTON HO.	15	19	66.3	66.2	64.2	66.6	66.2
10	DORSET TOWER	18	17	54.5	54.3	47.1	53.2	53.1
11	NORMANSEL TO.	18	16	52.2	39.3	48.8	49.0	48.4
12	SALISBURY TO.	20	20	61.8	56.8	58.5	54.7	59.1
13	BARRY JACKSON	20	16	59.7	49.4	53.2	52.0	54.7

The ascending (priority for any remedial action) order of the thirteen case study blocks according to the social appraisal approach scores are shown in figure 6-2. This priority depends mainly on the level of satisfaction and attitude of the respondents toward the study blocks.

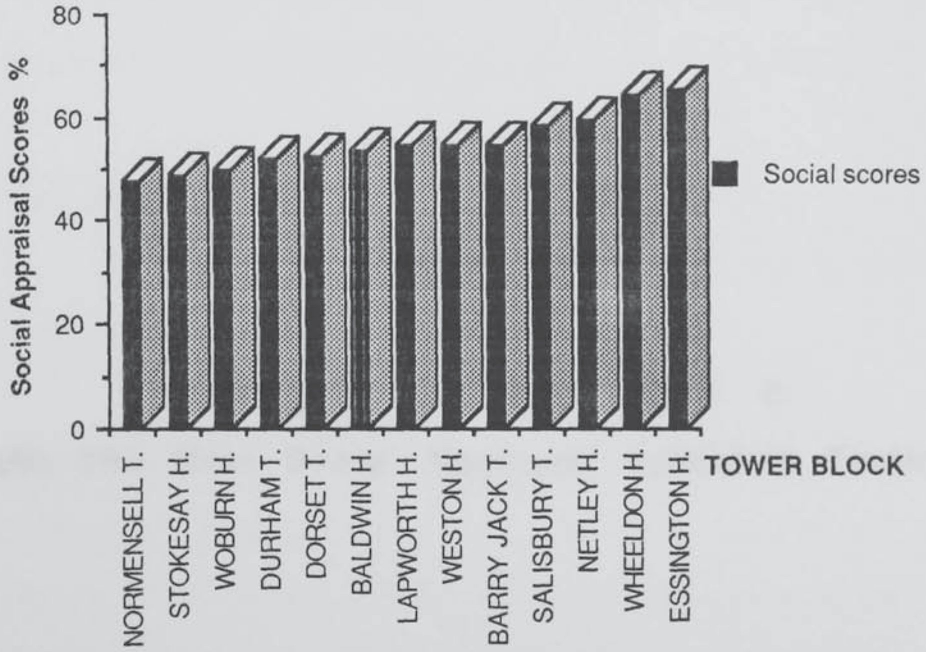


Figure 6-2 Ascending order of the 13 case study blocks according to the social appraisal scores.

The main social appraisal findings will be discussed in the following chapter as a continuation of the results with discussion of the social appraisal approach.

Chapter Seven

RESULTS AND DISCUSSION II:

(B) The Main Social Appraisal Approach Findings:

It can be seen that the social appraisal approach adopted for the case studies indicates a number of general problems and defects relating to multi-storey dwelling blocks. These problems and defects affect the residents satisfaction and their attitudes toward this sort of accommodation. The frequency with which these problems and defects occurred varied between blocks, yet many of them were common to the majority of the blocks surveyed. The main problems and defects can be summarised according to the two main subjects of the appraisal technique, as follows :

7.1 Physical Factors:

The main findings were arranged due to the main branches of the physical appraisal approach used in this study (see chapter four):

7.1.1 Structure:

There were very few comments made about the structural condition of the blocks. This could be because most of the respondents have no experience of the nature of the structural defects and how they may be recognized. However, some of the respondents made slight notes about some cracks in some of the case study blocks, which were taken into account in the physical appraisal survey. The main structural defects which were mentioned by some respondents were transmission of sound and smells from one dwelling to another and water penetration through the roof.

On the whole, the respondents showed no strong feelings about the structural condition in relation to the types of the study blocks.

7.1.2 Finishes:

In general, the level of satisfaction with the finishes category was in the positive scale. However, the social appraisal approach adopted indicates a number of general finishes defects relating to multi-storey dwelling blocks. These problems and defects were as follows:

1. There were many comments about the physical condition of the external cladding. Around 28% of the total respondents (268) "disagree" and "strongly disagree" with the physical condition of the external cladding and 30% were uncertain.
2. More than 53% of the total respondents "agree" and "strongly agree" that the plaster, wall covering and/or the painting are in good condition. A high level of agreement was found in blocks which had recently been refurbished such as Wheeldon House, Essington House, etc..
3. As to the general condition of the doors and windows; one-third of the total respondents "disagree" and "strongly disagree" with their condition, while 54% agreed. The highest level of disagreement was found in study blocks which had not received any refurbishment since their original occupation, such as Stokesay House, Weston House, etc.. The level of satisfaction with the operation of the doors and windows were higher than that, where 57% of the total respondents agreed with this and only 26% disagreed.
4. The attitude toward the condition of the internal fixtures was generally good, and this depended mainly on the cure by residents themselves. The disagreement level with these was only 15% of the total respondents (268)
5. Sixty three percent of the total respondents were satisfied with the condition of the refuse chute-room and operation of the chute.
6. A high number (105) of the total respondents (268) of the study blocks complained of the condition of the front and rear doors. Thirty nine percent of them were disagreed that they are in good condition, while 48% agreed. The percentage agreement decreases if the results of the blocks which had recently been refurbished (such as Wheeldon House and Essington House) were ignored, this new agreement percentage would be only 34%. In other words;

two thirds of the respondents of the other 11 blocks complained about the condition of the main doors.

7. Similar figures, as were obtained for the condition of the main doors, were shown for the communal areas. Where 36% of the total respondents (excepting Wheeldon House and Essington House) agreed with the condition of the communal area. The highest disagreement level with the communal areas condition was 70% at Durham Tower. The main social factor in this point is the caretaker, where the residents would be very critical if the caretaker failed to keep the communal areas up to the high standards to which the great majority maintained in their own dwelling and the communal area of their floor. unfortunately, the most important factor in this point (i.e., the caretaker) was either missing or living outside some of the case study blocks which leads the deterioration of communal area to poor condition.

8. The most important finishes category in this sort of building is the security system. In this study, 53% of the total respondents (268) disagreed and a lot of them strongly disagreed that the security system in their block was properly used. This percentage goes up to 63% if Wheeldon House and Essington House are ignored. Nearly half of the study blocks have completely useless security systems, such as Durham Tower, Normansell Tower, Stokesay House, Woburn House, Baldwin House and Barry Jackson Tower. Even in Dorset Tower block which had a security camera monitoring system, the percentage of the satisfaction with the security system was 50% only.

7.1.3 Services:

The largest number responses were grouped around the middle of the scale in their attitude toward the services categories. The majority of them agreed (some strongly agreed) that there were no big problems with the adequacy of the water supply, plumbing and drainage systems in the study blocks. Also, there were no major complaints about the number of electrical switches and power points in the case studies. The main services categories that a lot of the respondents complained were:

1. Heating system:

The most extreme disagreement scores were found in the central heating system question. Where, 62% of the total respondents (268) disagreed (78% of them were "strongly disagree") that the central heating system in the dwellings is adequate. Only 26% of the total respondents agreed with the adequacy of the heating system, most of them have Gas Fired (GF) central heating (three study blocks). The majority of the respondents from the other 10 study blocks did not use their central heating, as shown in table 7-1.

Table 7-1 shows the percentages of the respondents who used the central heating system in each case study block, and those who did not use it and used another form of heating. Six of the case study blocks (Lapworth House, Stokesay House, Netley House, Weston House, Baldwin House and Salisbury Tower) have Electric Underfloor Heating System (EUF). The highest percentage of respondents using EUF heating system was 41.2% at Stokesay House, whilst none of the respondents used it at Lapworth House. This was principally due to the cost and inefficiency of it's operation. Electric Underfloor (EUF) heating systems are now around 20 years old and are reaching the end of their expected life (see chapter five). The majority of the other respondents used Electric Fires or other additional sources (see table 7-1).

Two of the case studies have Electric Ducted Air (EDA) central heating systems; namely, Durham Tower and Dorset Tower. 30% of the respondents at Durham Tower used the EDA central heating system, while only 5% at Dorset Tower

TABLE 7-1:

PERCENTAGES IN VARIOUS HEATING CATEGORIES THAT TENANTS ARE USED ON EACH BLOCK.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS)	CENTRAL HEATING	ELECTRICAL FIRE	%NO COMMENT	NOTES (CENTRAL HEATING TYPE)
1.	LAPWORTH HO.	13	19	-	100.0	-	Electrical Under-Floor Heating (EUF)
2.	DURHAM HOUSE	20	18	30.0	70.0	-	Electric Ducted Air Heating (EDA)
3.	STOKESAY HO.	11	23	41.2	52.9	5.9	Electrical Under-Floor Heating (EUF)
4.	NETLEY HOUSE	11	23	30.0	60.0	10.0	Electrical Under-Floor Heating (EUF)
5.	WHEELDON HO.	11	17	93.1	3.4	3.4	Gas Fired Central Heating
6.	WESTON HOUSE	13	21	22.2	66.7	11.1	Electrical Under-Floor Heating (EUF)
7.	WOBURN HOUSE	13	18	41.7	58.3	-	Electrical Storage Radiator (ESR)
8.	BALDWIN HO.	15	20	25.0	75.0	-	Electrical Under-Floor Heating (EUF)
9.	ESSINGTON HO.	15	19	55.9	35.3	8.8	Electrical Storage Radiator (ESR)
10	DORSET TOWER	18	17	5.0	70.0	25.0	Electric Ducted Air Heating (EDA)
11	NORMANSEL TO.	18	16	71.4	25.0	3.6	Gas Fired Central Heating
12	SALISBURY TO.	20	20	38.5	61.5	-	Electrical Under-Floor Heating (EUF)
13	BARRY JACKSON	20	16	85.7	14.3	-	Gas Fired Central Heating

used it. The cost, the size of the heating unit and the inefficiency were responsible for this non use. 70% of the respondents at the two towers used Electric Fires or other additional sources (see table 7-1).

Also, there are two of the case studies have Electric Storage Radiators (ESR) central heating system; namely Woburn House and Essington House. This system seems slightly better than the above two systems, the main problem of it are the cost, response time and heat output, with many elderly resident not fully understanding how to operate them to suit their requirements or efficiently. Of the respondents 55.9% and 41.7% respectively used the ESR central heating system at Essington and Woburn Houses. Most of the other respondents used mainly Electric Fires or other additional sources (see table 7-1).

The last three study blocks still have Gas Fired central heating, those are Wheeldon House, Normansell Tower and Barry Jackson Tower. Most of the respondents were pleased with its cost and performance. The lowest percentage of the respondents using the Gas Fired (GF) central heating system was 71.4% at Normansell Tower, whilst at Barry Jackson Tower and Wheeldon House, the figure was 85.7% and 93.1% respectively. The rest of respondents in each block used the Electric Fires or other additional sources (see table 7-1).

For all the study blocks, the highest percentage of the respondents used the building central heating system was 93.1% at Wheeldon House and the lowest was 0% at Lapworth House. As shown in table 7-1, the Gas Fired (GF) central heating systems are perceived to be more economic and efficient.

2. Lift(s):

In these blocks, the lift was the main service facility about which every resident had something to say. In this study, a general atmosphere of concern about the lift(s) was reflected in the fact that one third of the total respondents were dissatisfied. Fifty nine percent of the total respondents agreed that the lift(s) did work very well. This percentage would decline sharply if the study blocks in which the lift(s) had been refurbished are ignored.

Figure 7-1 shows the ascending order of the percentage of the level of satisfaction with the lift(s) for all case study blocks. The highest level of satisfaction with the lift(s) was 100% at Wheeldon House and the lowest 25% at Lapworth House. The variation in the level of satisfaction with the lift(s) depended mainly on the age of the lift itself, in its basic reliability, in the efficiency of its maintenence, in the interval of its maintenance and in the caretaker's ability to deal with the minor trouble which they are authorized to handle.

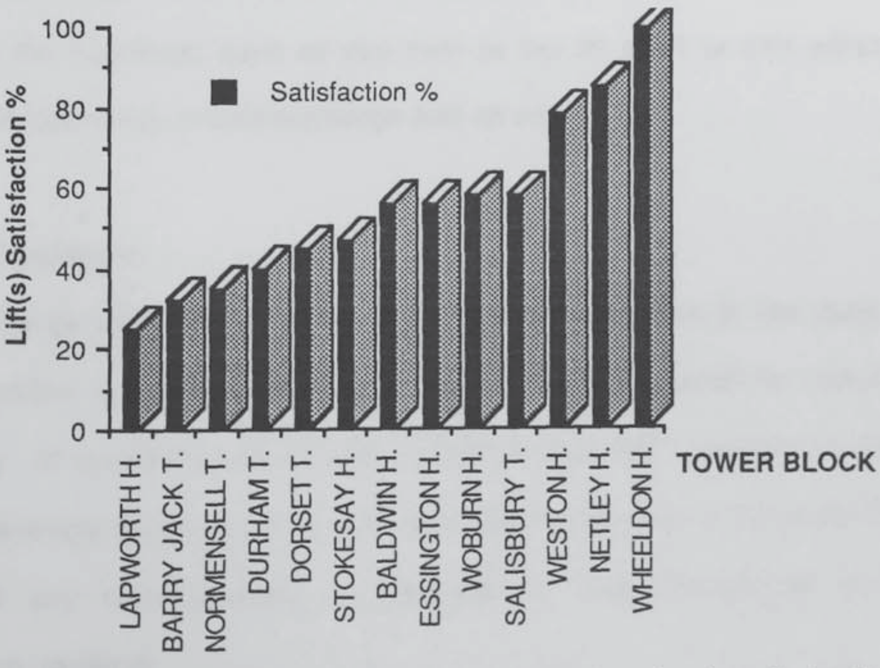


Figure 7-1 Ascending order of the level of satisfaction with the lift(s) at the 13 case study blocks

In summary, the lift plays such a vital role in the residents' lives that all aspects of its use ought not to be just tolerable, but be positively satisfactory.

3. Noise:

Another unsatisfactory feature in the service category in these multi-storey dwelling blocks, to which almost every respondent referred spontaneously, was noise. In this study, 43% of the total respondents (268) agreed (more than half of them were "strongly agree") that noise is a problem of living in their particular dwelling. About the same percentage disagreed with this. Most of the respondents agreeing lived on the lower floors.

The most unpopular floor was ground level. It is perceived as being very noisy, with nuisance from children living around the block and to the proximity of play-grounds, garages, or less often, a busy railway line (as in Essington House) or motorway (as in Barry Jackson Tower).

Some respondents, also complained about the noise that was due to the physical layout of the buildings; such as one next to the lift shaft or one adjucent to refuse containers into which chutes discharge and so on.

4. Ventilation:

The general attitudes toward the form of ventilation in the study blocks were in the positive scale. However, there were a lot of respondents complaining of the efficiency of ventilation, where around 29% of the total respondents disagreed, 40% of them strongly disagreed. This was mainly because most of the study blocks had not received any refurbishment or cleaning of their mechanical and permanent ventilation systems.

7.1.3 Environment:

On the whole, the attitude toward the environmental categories was good, where 56.7% of the total respondents were satisfied and only 24.5% were not. There were no big complaints about the physical layout of the green area and the footpaths around the blocks. In some case studies, there were few complaints about the parking facilities and the health problems that were perceived as being associated with living in this sort of accommodation.

The main environmental problems of which many of the total respondents complained were as follows:

1. Children play area:

Although, the number of children in the study blocks was very small, there were a lot of complaints about the available facilities for children to play on the estate. Thirty five percent (94) of the total respondents (268) disagreed that there were enough play facilities for children on their estate, while 40% (107) agreed. This dissatisfaction was mainly due to children who were living around the study blocks. Around the same percentage rates of "agree" and "disagree" were found in the answers to the question: "Children playing around the blocks made problems".

So, if there were enough play area facilities for the children in each estate, this could increase the level of satisfaction of the residents with the environment of the blocks.

2. Public services:

Only one quarter of the total respondents disagreed that the public services on their estate are adequate, even in the block with the highest level of satisfaction. Most of them were elderly people. This might give a clear indication of the reason behind this percentage of disagreement, where 48% of the total respondents were 65 years old or over (see chapter six).

3. Health and shopping facilities:

One third of the total respondents complained of the inadequacy of the health and shopping facilities around the study blocks. Again, this may well have been principally because there were a lot of elderly people in the study blocks.

4. Public phone:

There was no question in the social appraisal questionnaire about the availability of public phones, which might affect the satisfaction level with the environmental category. The discussion of this important item depends mainly on the respondents comments in the open questions in part four of the appraisal questionnaire. The residents of most study blocks complained frequently about the absence of a public phone box in the block. Even, if one existed there, the main problem was vandalism to it. Many of total respondents had no phone and the figure was much lower in the case of the one-person elderly households.

7.2 Social Factors:

The main findings of social factors which tended to influence the general level of satisfaction and attitude toward multi-storey dwelling blocks were as follows:

7.2.1 Difference between dwelling, block and estate satisfaction:

Dwelling, block and estate satisfaction were found to vary a great deal from block to block in the case study blocks. Table 7-2 shows that in general the residents were less satisfied with their block than with their estate and less satisfied with their estate than with their dwelling.

TABLE 7-2:

Percentage rates of satisfaction level with dwelling, block and estate for the 13 case study blocks:

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	Dwelling	Block	Estate
1.	LAPWORTH HO.	13	19	65.6	52.2	62.5
2.	DURHAM HOUSE	20	18	68.6	46.9	30.3
3.	STOKESAY HO.	11	23	49.6	38.4	47.0
4.	NETLEY HOUSE	11	23	73.6	69.0	80.0
5.	WHEELDON HO.	11	17	80.3	79.4	96.6
6.	WESTON HOUSE	13	21	56.0	55.2	66.7
7.	WOBURN HOUSE	13	18	60.4	35.9	50.0
8.	BALDWIN HO.	15	20	64.1	47.6	56.3
9.	ESSINGTON HO.	15	19	79.0	77.8	88.2
10	DORSET TOWER	18	17	53.2	44.9	60.0
11	NORMANSEL TO.	18	16	54.2	35.2	42.9
12	SALISBURY TO.	20	20	72.8	59.9	76.9
13	BARRY JACKSON	20	16	61.9	39.9	42.9
The Total Respondents (268)				66.9	54.8	64.0

In all the study blocks, the level of satisfaction with the dwelling was higher than with the block. While, most of the study blocks show that the estate satisfaction was higher than the block satisfaction. The highest proportions of satisfied tenants with all of the three was found in Wheeldon House, where 80.3%, 79.4% and 96.6% of the block respondents were satisfied with dwelling, block and estate respectively. The lowest dwelling satisfaction was found in Stokesay House (49.6%), the lowest block satisfaction was found in Normansell Tower (35.2%) and the lowest estate satisfaction was 30.3% in Durham Tower.

Of the whole, two-thirds of the total respondents were satisfied with the dwelling and only 21.2% were dissatisfied. The estate satisfaction came second, where 64% of the total respondents were satisfied and 20 %were dissatisfied with the estate. Finally, the block satisfaction was lowest, where 54.8% of the total respondents were satisfied with the block and 27.7% were dissatisfied, as shown in figure 7-2.

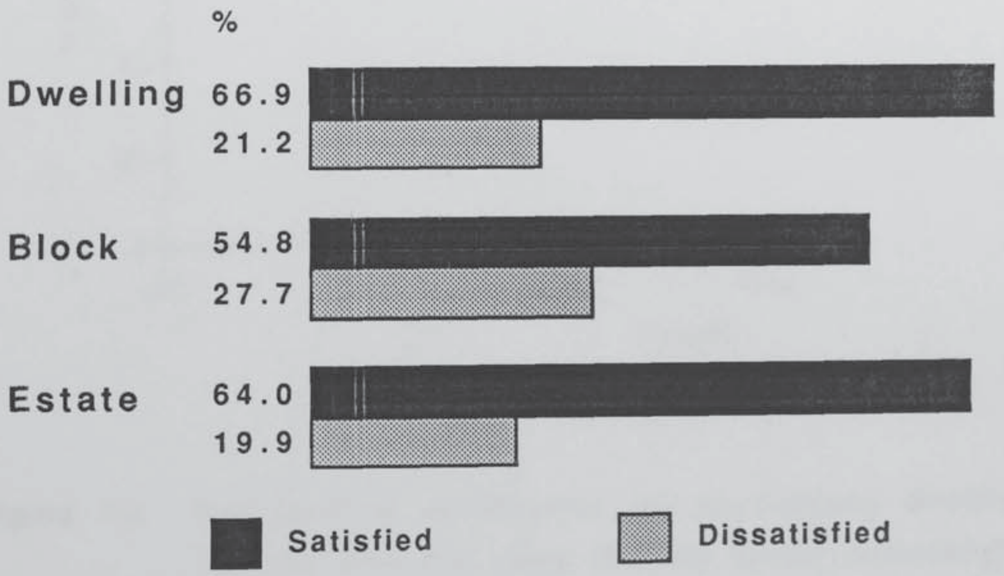


Figure 7-2 **Satisfaction and dissatisfaction percentages with dwelling, block and estate for the total sample.**

Other surveys [11,70,72] have reported almost similar differences between the dwelling, block and estate satisfaction. Their findings of dwelling, block and estate satisfactions were slightly higher than the findings of this study. The main agreement findings that council tenants are usually less satisfied with their block (as a high-rise building) than with their estate or dwelling.

If a simple correlation was attempted between this study findings and the findings of some previous studies[11,70,72] of the dwelling, block and estate satisfactions with the time, it would be seen that, in general the level of satisfaction and the attitude of the people to multi-storey dwelling blocks is decreasing with time, as shown in figure 7-3, for the blocks nationally.

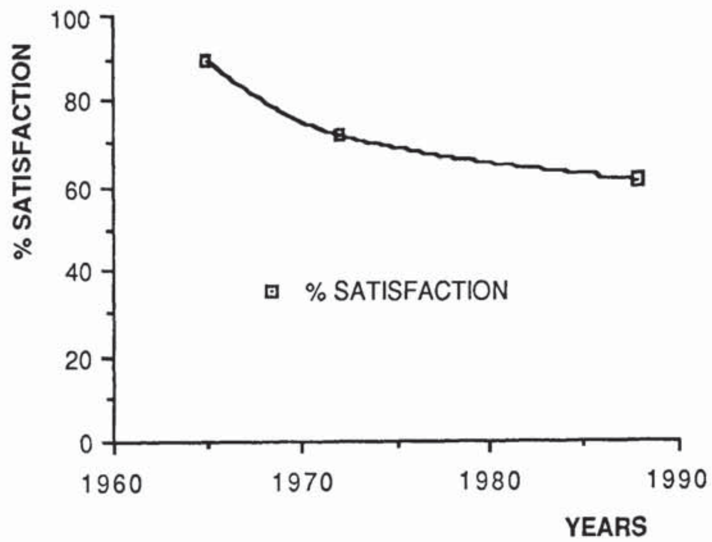


Figure 7-3 The level of satisfaction for multi-storey dwelling blocks over the years (for the blocks nationally)

7.2.2 Height satisfaction:

The height of the multi-storey dwelling blocks is one of the most significant factors which adversely affects the attitude of most people toward this sort of accommodation. These dissatisfactions and negative attitudes were proved in most of the previous studies[68,76]. The results of this study showed that a majority of the respondents were not content with the high-rise living, and the numbers dissatisfied were significant, even in blocks with a high level of satisfaction, such as Wheeldon and Essington Houses. Table 7-3 shows the percentage rates in various accommodation types that people ideally like to live in at each study block.

The majority of respondents stated as preference for living in houses, as shown in table 7-3. The highest percentage of respondents who preferred houses was 80% at Netley House and the lowest was 26.9% at Salisbury Tower. A significant number of respondents prefer low-rise building with not more than 3 storeys height, the highest number of respondents was 41.7% at Woburn House and the lowest was only 3.4% at Wheeldon House.

Most of the respondents in more than three-quarters of the study blocks disliked living in high-rise buildings, while only in three case studies was there a significant number of respondents who were satisfied and liked living in their blocks. These were; Wheeldon House with highest percentage (65.5%), Salisbury Tower (34.6%) and Essington House (32.4). This was mainly because these three blocks had recently been converted to Vertical Warden Schemes (VWS)[77].

In general, 56% of the total respondents stated a preference for living in houses and around 20% prefered low-rise building with not more than 3 storeys height. 20% of the total respondents prefered to stay in their dwellings in the high-rise building and only 5% made no response.

TABLE 7-3:

PERCENTAGES IN VARIOUS ACCOMMODATION TYPES THAT PEOPLE IDEALLY LIKE TO LIVE IN ON EACH BLOCK.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	HOUSE	LOW-RISE BUILDING	HIGH-RISE BUILDING	%NO RESPONSES
1.	LAPWORTH HO.	13	19	62.5	25.0	12.5	-
2.	DURHAM HOUSE	20	18	60.0	20.0	20.0	-
3.	STOKESAY HO.	11	23	64.7	29.4	-	5.9
4.	NETLEY HOUSE	11	23	80.0	5.0	5.0	10.0
5.	WHEELDON HO.	11	17	27.6	3.4	65.5	3.4
6.	WESTON HOUSE	13	21	55.6	33.3	11.1	-
7.	WOBURN HOUSE	13	18	41.7	41.7	8.3	8.3
8.	BALDWIN HO.	15	20	50.0	18.8	18.8	12.6
9.	ESSINGTON HO.	15	19	47.1	17.6	32.4	2.9
10	DORSET TOWER	18	17	70.0	10.0	10.0	10.0
11	NORMANSEL TO.	18	16	75.0	21.4	3.6	-
12	SALISBURY TO.	20	20	26.9	11.5	34.6	11.5
13	BARRY JACKSON	20	16	60.7	21.4	10.7	7.1
The Total Respondents (268)				56.0	19.0	20.0	5.0

7.2.3 Dwelling satisfaction (for the re-cycling concept):

Dwelling satisfaction of the multi-storey dwelling blocks is one of the most significant factors which have an indirect bearing the concept of recycling as an alternative solution (see chapter nine), in which the building is dismantled into its original components, and each component is then incorporated as an element in a large construction or in a new sequence of low-rise buildings (see chapter three). If this alternative solution were adopted, the multi-storey dwelling blocks could be converted to many low-rise buildings with the same dwellings layout.

So, according to this concept, the attitude of the residents was examined indirectly by this question: "In low-rise building, do you prefer the same layout of the dwelling?". Table 7-4 shows the percentage of the respondents who would prefer the same layout of the dwelling in low-rise buildings in each study block and for the all study blocks collectively.

The highest percentages of respondents who said "yes" (i.e., prefer the same dwelling layout) were again with the high satisfaction blocks, namely: Wheeldon House (62.1%) and Essington House (61.8%). Even in the low satisfaction blocks, there were a significant number of respondents who prefer the same layout for their dwelling such as; Normansell Tower (35.7%), Stokesay House (35.3%) and Woburn House (41.7%). One-third was the highest number of respondents who did not prefer the same layout of their dwelling.

For all the study blocks, around half of the total respondents prefered the same layout of their dwellings, while only 17% of the total respondents did not prefer it. At the same time, there were 35% of the total respondents who were unable to make a response to this question.

TABLE 7-4:

PERCENTAGES OF RESPONDENTS WHO PREFER THE SAME LAYOUT OF THE DWELLING IN LOW-RISE BUILDING. (QUEST. 257, SEE APPENDIX VII).

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	%YES (PREFER)	%NO (DO NOT PREFER)	% DO NOT KNOW OR NO COMMENT
1.	LAPWORTH HO.	13	19	25.0	12.5	62.5
2.	DURHAM HOUSE	20	18	40.0	30.0	30.0
3.	STOKESAY HO.	11	23	35.3	35.3	29.4
4.	NETLEY HOUSE	11	23	50.0	15.0	35.0
5.	WHEELDON HO.	11	17	62.1	-	37.9
6.	WESTON HOUSE	13	21	33.3	11.1	55.6
7.	WOBURN HOUSE	13	18	41.7	33.3	25.0
8.	BALDWIN HO.	15	20	56.3	6.3	37.5
9.	ESSINGTON HO.	15	19	61.8	2.9	35.3
10	DORSET TOWER	18	17	10.0	35.0	55.0
11	NORMANSEL TO.	18	16	35.7	25.0	39.3
12	SALISBURY TO.	20	20	38.5	19.2	42.3
13	BARRY JACKSON	20	16	46.4	28.6	25.0
The Total Respondents (268)				48.0	17.0	35.0

7.2.4 Vandalism and Insecurity:

The residents were inclined to ascribe any misuse of their block and estate to vandalism, and to dismiss the wear and tear that is inevitable if there are children about the place. There were, however, endless examples of deliberate damage at many of the study blocks. There were also quantities of graffitti in corridors, staircase walls, garages, ceilings and floors. There were, also, some residents who had been victims or had been affected by one or more crimes, such as burglary, car theft, theft from car, mugging, assaults, etc.. In fact, this could be almost any where except in the block with a good security system or/and under good control (i.e., either warden or good caretaker), which could be reduced to the minimum.

All these crimes lead to increase the feeling of insecurity among the residents of the block. Table 7-5 shows the percentage rates of the respondents in various satisfaction categories in each block for safety and vandalism.

The highest level of satisfaction with the safety and vandalism was 74.2% at Wheeldon House and 67.6% at Essington House. Both blocks were under good control (Vertical Warden Scheme). The highest percentage of respondents, were dissatisfied with the safety and vandalism at their blocks, was in Durham Tower and Woburn House, where their dissatisfaction level in these blocks were 95% and 91.6% respectively. Most of the respondents in the other study blocks were dissatisfied with the safety and vandalism, see table 7-5.

Although, there was a Vertical Warden Scheme at Salisbury Tower and Camera security system at Dorset Tower, a significant number of respondents (42.3% and 42.5% respectively) suffered from insecurity and vandalism.

TABLE 7-5:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR SAFETY AND VANDALISM (QUESTS. 345+348).

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	SATISFIED	IN BETWEEN	DISSATISFIED	%NO RESPONSES
1.	LAPWORTH HO.	13	19	43.8	25.0	31.3	-
2.	DURHAM HOUSE	20	18	-	5.0	95.0	-
3.	STOKESAY HO.	11	23	14.7	17.6	67.6	-
4.	NETLEY HOUSE	11	23	30.0	27.5	42.5	-
5.	WHEELDON HO.	11	17	74.2	12.1	13.8	-
6.	WESTON HOUSE	13	21	16.7	11.1	72.2	-
7.	WOBURN HOUSE	13	18	-	8.3	91.6	-
8.	BALDWIN HO.	15	20	3.1	15.6	81.2	-
9.	ESSINGTON HO.	15	19	67.6	17.6	14.7	-
10	DORSET TOWER	18	17	20.0	37.5	42.5	-
11	NORMANSEL TO.	18	16	8.9	17.9	73.2	-
12	SALISBURY TO.	20	20	32.6	25.0	42.3	-
13	BARRY JACKSON	20	16	7.2	33.9	57.1	1.8
The Total Respondents (268)				29.9	18.7	51.4	0.5

For all the study blocks, 51.4% of the total respondents were dissatisfied with safety and vandalism, while 29.9% were satisfied. Only 18.7% of the total respondents were in between or uncertain. Other surveys in the multi-storey dwelling blocks have reported quite similar levels of satisfaction with the safety and vandalism [77,91].

7.2.5 The elderly:

In general satisfaction amongst the elderly was related to how far they felt themselves to be still part of the community, rather than in situations where they were socially isolated. So, in the case of the blocks with Vertical Warden Schemes, the community relations were good and the level of satisfaction was high; as in Wheeldon House, Essington House and Salisbury Tower. In the other ten blocks, most of elderly respondents complained of suffering mainly from the following points:

1. Social isolation;
2. Noise from the children around their block, the lift, the neighbours, etc.;
3. The security system of their blocks;
4. Insecurity and vandalism; and
5. A lack of help or care from the other residents, especially from young neighbours.

In addition to those, many elderly people preferred to move either to houses or to any other building under Warden control.

Birmingham City has apparently made multi-storey dwelling blocks into acceptable homes for elderly people by converting them to Vertical Warden Schemes (VWS) serviced blocks. Taking into account that the separation of the elderly people from the younger age group would go some way towards overcoming the conflicting life style of the different age groups.

7.2.6 Families with children:

A very limited number of children have been found in the case study blocks. It is now Birmingham's policy to avoid letting dwellings in high-rise blocks to families with children.

This study found that the multi-storey dwelling blocks were quite unsuitable accommodation for families with children. The level of satisfaction with most "No child" blocks was higher than those which have families with children living in or close to the block. The families with children themselves were mostly dissatisfied and wanted to move to other sorts of accommodation which are more suitable for the children. In addition to that, there was a correlation between children in the high-rise buildings and vandalism, graffitti and other social problems.

This study suggested that the Birmingham's policy is correct and this embargo should be maintained and extended to cover all existing multi-storey dwelling blocks.

7.2.7 Some general social topics:

There are many other social factors tending to influence the general level of satisfaction and attitude toward multi-storey dwelling blocks. Most of them were less significant than those mentioned above, and were as follows:

1. Lack of privacy:

Number of complaints were received on the lack of privacy, where around one-quarter of the total respondents agreed that there was a lack of privacy, living in this sort of building.

2. The dwelling size:

There were a limited number of respondents who wanted to move from one-bedroom dwelling to two-bedroom accommodation. The main reasons for this were the desire to accommodate a relative or close friend visiting and/or as additional storage facilities.

3. The neighbours:

In general, there were few complaints about the neighbours, as only 11% of the total respondents thought that the neighbours are not friendly people and most of them were from elderly respondents. Around three-quarters of the total respondents were satisfied with their neighbours.

7.3 Analysis of Factors Influencing Respondents' Satisfaction Living in Multi-storey Dwelling Blocks:

Several types of statistical analysis were used to examine the individual and collective contribution of Biographical data, dwelling and block-related characteristics, social, physical and environmental factors toward explaining the variance of the residents' satisfaction and attitude toward living in multi-storey dwelling blocks. The relationship between the satisfaction level of respondents and their attitude toward living in a multi-storey dwelling block and several independent variables was measured using some statistical correlation analyses (t-test, Kendall's Tau and r-coefficient, etc., see chapter six). The number of social appraisal variables (see Appendix IX) was reduced into 37 variables only, as shown in table 7-6. Taking into account the most important factors which were proved that most of the respondent complained from them, in addition to the combination of some sub-items to make them one variable, as in dwelling and block categories, see table 7-6. The discussion of these is summarised according to the type of the statistical analysis in the following subsections:

Table 7-6 : The specific variables studied and the statistical techniques used to examine their contribution to explaining the variance in satisfaction and attitude toward the living in multi-storey dwelling block.

Variable Name	Variable Label	Type of statistical Test used
1. Biographical Data:		
FLOOR	Floor Number	Correlation-coef.
DWELLS	Size of Dwelling	t-test
SEX	Sex of respondent	t-test
AGE	Age of respondent	ANOVA
MARITAL	Marital Status	ANOVA
OCCUP	Occupation	ANOVA
PEOPN	How many people live at this address?	ANOVA
CHILDN	Number of children living at this address	ANOVA
YEARL	How long have you lived at this block	Correlation-coef.
2. Dwelling Appraisal:		
LROOM	Living Room (in general)	Correlation-coef.
BROOM	Bed Room(s) (in general)	Correlation-coef.
KITCHEN	Kitchen (in general)	Correlation-coef.
WBATH	Bathroom & W.C. (in general)	Correlation-coef.
DWELL	The Dwelling (in general)	Correlation-coef.
B224	The insulation	Correlation-coef.
D251	The physical layout of the dwelling	Correlation-coef.
D257	The same layout of the dwelling	t-test
3. Block Appraisal:		
FINISH	Finishes (in general)	Correlation-coef.
F318	The communal areas	Correlation-coef.
F319	The security system in the block	Correlation-coef.
SERVIC	Services (in general)	Correlation-coef.
S321	The central heating systems	Correlation-coef.
S325	The lift(s)	Correlation-coef.
S326	The form of ventilation	Correlation-coef.
S327	Noise	Correlation-coef.
ENVIR	Environment (in general)	Correlation-coef.
E331	Public services on the estate	Correlation-coef.
E336	Children play area	Correlation-coef.
E337	Health problems associated	Correlation-coef.
BL341	The physical layout of the block	Correlation-coef.
BL345	Safety	Correlation-coef.
BL346	The estate	Correlation-coef.
BL347	Neighbours	Correlation-coef.
BL348	Vandalism	Correlation-coef.
4. General Information:		
ACCOM	Ideally like accommodation	Correlation-coef.
HEIGHT	The maximum storey height of blocks	Correlation-coef.
HEATS	The use of centeral heating system	t-test
Some variables above:	Either individual or collective	Multiple Regression

NOTE: See Appendix (IX) for the complete subject of the above variables.

7.3.1 t-test Analyses:

To compare the differences in satisfaction level of people within different categories (grouped by various nominal variables) t-test analyses were done for the total respondents sample (268). Two variables of Biographical data (dwelling size and sex of respondents) and two other related variables (the dwelling layout and the use of central heating systems) were analyzed. One was statistically significant in terms of satisfaction level, at the 0.01 level of significance. The mean satisfaction score (satisfaction level) of the respondents who prefered to live in the same layout of the dwelling was significantly higher than the mean satisfaction score of those who did not prefer the same layout of the dwelling.

Table 7-7 : t-values for mean satisfaction scores on Nominal independent variables

	Variables	N	Mean Sat. score (%)	Standerd Deviation	t-value	Probability (SIG.)
1.	DWELLS (Size of the dwelling):					
	One-bedroom	93	62.2	18.6	1.861	0.0642
	Two-bedroom	164	56.7	20.9		
2.	SEX (Sex of respondents):					
	Male	107	57.3	21.3	0.871	0.3850
	Female	150	59.8	19.6		
3.	D257 (prefer same layout of the dwelling):					
	Yes	129	64.7	16.9	3.873*	0.0000
	No	46	44.3	22.5		
4.	HEATS (The use of central heating system):					
	Yes	150	60.7	19.0	0.965	0.3959
	No	103	56.7	22.6		

* Significant at 0.01 level.

There were no statistically significant differences between the mean satisfaction score of the respondents and for the following variables:

(a). The sex of the respondent;

(b). The size of dwelling ; and

(c). The use of central heating system.

Table 7-7 shows the means (in percentage rates), standard deviations, t-values and probability (the significance) for each of the variables that was analyzed by t-test.

7.3.2 Statistical Correlations:

The relationship between the satisfaction level of respondents and their attitude toward living in a multi-storey dwelling blocks and several independent variables was measured using some statistical correlation analyses. Kendall's tau-correlation coefficient (t -used for all variables measured using rankable - ordinal- scale) and Pearson's r-coefficient analyses. Table 7-8 shows that a significant relationship was found between respondents' satisfaction and attitudes toward living in a multi-storey dwelling block and several dwelling and block-related characteristics, social, physical and environmental factors ($p < 0.01$). The N indicates the number of cases used in calculating the correlation, and this number is different for each pair because the number of missing cases was not the same for all variables. The direction and strength of the individual correlations were as follows:

1. A negative relationship ($r = -0.114$, $p = 0.058$) between the respondents' satisfaction and the floor level (the number of floor which is occupied by the respondent).
2. A positive relationship ($r = 0.456$, $p < 0.01$) between the respondents' satisfaction and the general condition of the living room.
3. A positive relationship ($r = 0.382$, $p < 0.01$) between the respondents' satisfaction and the general condition of the bed-room(s).
4. A positive relationship ($r = 0.313$, $p < 0.01$) between the respondents' satisfaction and the general condition of the kitchen.
5. A positive relationship ($r = 0.408$, $p < 0.01$) between the respondents' satisfaction and the general condition of the bathroom and W.C..

Table 7-8 : Intercorrelation of biographical, dwelling and block-related variables and respondents' satisfaction and attitude toward the living in multi-storey dwelling blocks.

	Variable Name	r	p	N
1.	**Biographical Data:**			
	FLOOR (Floor Number)	-0.1140	0.050	245
	YEARL (length of occupation)	0.0023	0.487	254
2.	**Dwelling Appraisal:**			
	LROOM (Living Room, in general)	0.4561	0.000	265
	BROOM (Bed Room(s), in general)	0.3816	0.000	265
	KITCHEN (Kitchen, in general)	0.3127	0.000	265
	WBATH (Bathroom & W.C., in general)	0.4080	0.000	265
	DWELL (The Dwelling, In general)	0.3039	0.000	265
	B224 (The insulation)	0.4362	0.000	266
	D251 (The physical layout of the dwelling)	0.4739	0.000	263
3.	**Block Appraisal:**			
	FINISH (Finishes, in general)	0.3677	0.000	265
	F318 (The communal areas)	0.4788	0.000	264
	F319 (The security system in the block)	0.5054	0.000	263
	SERVIC (Services, in general)	0.6478	0.000	266
	S321 (The central heating systems)	0.2821	0.000	266
	S325 (The lift(s))	0.4800	0.000	266
	S326 (The form of ventilation)	0.3351	0.000	267
	S327 (Noise)	0.4237	0.000	264
	ENVIR (Environment, in general)	0.4481	0.000	266
	E331 (Public services on the estate)	0.3060	0.000	263
	E336 (Children play area)	0.2686	0.000	260
	E337 (Health problems associated)	0.0500	0.298	255
	BL341 (The physical layout of the block)	0.4839	0.000	259
	BL345 (safety)	- 0.3729	0.000	267
	BL346 (The estate)	0.7000	0.000	267
	BL347 (Neighbours)	0.5173	0.000	266
	BL348 (Vandalism)	- 0.5468	0.000	267
4.	**General Information:**			
	ACCOM (Ideally like accommodation)	0.0521	0.310	255
	HEIGHT (height of block)	0.3204	0.000	260

NOTE: See Appendix (IX) for the complete subject of the above variables.
* Significant at 0.01 level.

6. A positive relationship ($r = 0.304$, $p < 0.01$) between the respondents' satisfaction and the general condition of the dwelling.

7. A positive relationship ($r = 0.436$, $p < 0.01$) between the respondents' satisfaction and the general condition of the insulation.

8. A positive relationship ($r = 0.474$, $p < 0.01$) between the respondents' satisfaction and the physical layout of the dwelling.

9. A positive relationship ($r = 0.368$, $p < 0.01$) between the respondents' satisfaction and general conditions of the finishes categories.

10. A positive relationship ($r = 0.648$, $p < 0.01$) between the respondents' satisfaction and general conditions of the services categories.

11. A positive relationship ($r = 0.448$, $p < 0.01$) between the respondents' satisfaction and general conditions of the environmental categories.

12. A positive relationship ($r = 0.479$, $p < 0.01$) between the respondents' satisfaction and communal areas condition.

13. A positive relationship ($r = 0.506$, $p < 0.01$) between the respondents' satisfaction and the security system of the block.

14. A positive relationship ($r = 0.282$, $p < 0.01$) between the respondents' satisfaction and the central heating system of the block.

15. A positive relationship ($r = 0.480$, $p < 0.01$) between the respondents' satisfaction and the condition of the lift(s) in the block.

16. A positive relationship ($r = 0.325$, $p < 0.01$) between the respondents' satisfaction and the ventilation form of the block.

17. A positive relationship ($r = 0.424$, $p < 0.01$) between the respondents' satisfaction and the noise in general, in the block.

18. A positive relationship ($r = 0.306$, $p < 0.01$) between the respondents' satisfaction and the public services around the block.

19. A positive relationship ($r = 0.484$, $p < 0.01$) between the respondents' satisfaction and the physical layout of the block.

20. A positive relationship ($r = 0.700$, $p < 0.01$) between the respondents' satisfaction and the general condition of the estate.

21. A positive relationship ($r = 0.517$, $p < 0.01$) between the respondents' satisfaction and the neighbours in the block.

22. A negative relationship ($r = -0.373$, $p < 0.01$) between the respondents' satisfaction and insecurity in and around the block.

23. A negative relationship ($r = -0.547$, $p < 0.01$) between the respondents' satisfaction and the vandalism in and around the block.

24. A positive relationship ($r = 0.269$, $p < 0.01$) between the respondents' satisfaction and the children play areas near the block.

25. A positive relationship ($r = 0.321$, $p < 0.01$) between the respondents' satisfaction and the maximum storey height of block should be which was thought by the respondents.

Even though all the above relationships studied were statistically significant, strongest relationships were between the respondents' satisfaction and general condition of the estate and the condition of services categories.

Also, table 7-8 shows that no statistically significant relationships were found between respondents' satisfaction and attitudes toward living in a multi-storey dwelling block and the following dwelling and block-related factors ($p > 0.01$):

1. The length of dwelling occupancy ($p = 0.487$, one-tailed);
2. The ideally liked accommodation ($p = 0.310$, one-tailed); and
3. The health problems associated with high-rise living ($p = 0.298$, one-tailed).

7.3.3 Analysis of Variance (ANOVA):

Differences among respondents' satisfaction and attitudes toward living in a multi-storey dwelling block for some biographical data were statistically tested using the analysis of variance (ANOVA) technique at the 0.01 level of significance. The hypothesis to be tested for each independent variable was:

"There is no significant difference in respondents satisfaction and attitudes toward the living in a multi-storey dwelling block among the categories for each variable."

Table 7-9 shows the degree of freedom (D.F.), F-ratio and F-probability for each of the variable that was analyzed by ANOVA test. The analyses indicated the following:

1. The null hypothesis stating no difference in respondents' satisfaction mean scores among the age of respondent categories was rejected at the 0.01 level of significance. In other words, there was a significant difference in respondents' satisfaction and attitude among various categories of the age of respondents. Where, there was a positive relationship (r = 0.217) between the respondents' satisfaction and the age of the respondents .

2. The null hypothesis stating no difference in respondents' satisfaction mean scores among the marital status categories was accepted at the 0.01 level of significance. In other words, there was no significant difference in respondents' satisfaction among various categories of the marital status.

Table 7-9 : F-ratios for respondents' satisfaction mean scores grouped by selected biographical variables in ANOVA

		ANOVA		
	Variables	D.F.	F-ratio	F-prob.
1.	AGE (Age of respondent)	259	4.85*	0.000
2.	MARITAL (Marital status)	259	2.26	0.063
3.	OCCUP (Respobents' occupation)	257	1.57	0.125
4.	PEOPN (Number of people in each dwelling)	259	0.78	0.638
5.	CHILDN (Number of children in each dwelling)	21	1.29	0.275

NOTE: See Appendix (IX) for the complete subject of the above variables.
* Significant at 0.01 level.

3. The null hypothesis stating no difference in respondents' satisfaction mean scores among the categories of occupation of the respondents was accepted at

the 0.01 level of significance. This means there was not a significant difference in respondents' satisfaction and attitude according to occupation.

4. The null hypothesis stating no difference in respondents' satisfaction mean scores according to the number of people living at each dwelling was accepted at the 0.01 level of significance. This means there was not a significant difference in respondents' satisfaction and the number of people living in each dwelling.
5. The null hypothesis stating no difference in respondents' satisfaction mean scores according to the number of children (under 16 years) living at each dwelling was accepted at the 0.01 level of significance. This means there was not a significant difference in respondents' satisfaction and the number of children living in each dwelling. The result of the analysis with this point is not quite confident because the number of cases were very limited (only 23 cases).

By ANOVA analysis, only one variable was found to have a significant effect on residents' satisfaction and attitudes toward the high-rise living; it was the age of the respondents. The result of the number of children variable must be ignored because of the limited size of the sample and all the previous studies proved that there was a significant relationship between the residents' satisfaction and the number of children [70].

7.3.4 Multiple Regression Analyses:

Multiple regression analysis was used in this study to examine the individual and collective contribution of the independent variables toward explaining the variance of the criterion variable (the respondents' satisfaction). This technique was used in this study for checking the results of the other used statistical techniques. The dependent variable was the respondents' satisfaction, where the independent variables were most of the biographical data variables (see table 7-6).

Once again, the variables most highly correlated with the respondents' satisfaction and attitude were the floor level and the age of the respondents, while the others did not significantly affect the respondents' satisfaction. The results of this technique are not mentioned in detail, mainly because their similarity with the results of the other used techniques.

For some other variables, generally, there were no significant relationships between the following factors;

a. The floor number which was lived by respondent and the ideally preferred accommodation.

b. The sex of the respondent and the ideally preferred accommodation.

c. The age of the respondent and the ideally preferred accommodation.

d. The occupation of the respondent and the ideally preferred accommodation.

There was a significant relationship between the following factors;

a. The age of the respondents and who preferred the same layout of the dwelling.

b. The occupation of the respondents and who preferred the same layout of the dwelling.

Multiple regression analyses were used in the examination the significant of the above relationships.

Chapter Eight

PHYSICAL AND SOCIAL INTEGRATION RESULTS AND DISCUSSION

The study appraisal technique indicates a number of physical defects and social problems associated with the thirteen multi-storey dwelling blocks of large concrete panel construction which were studied in this research, as shown in chapters 5,6 and 7. The most probable alternative solutions for physical and social factors of this sort of building were discussed, in general, in chapter nine. The question now remains, which block has priority in any remedial programme and what is the ranking of these study blocks?

This chapter trys to address this question by ranking the study blocks according to their physical and social condition, additionally it presents some statistical results obtained by testing the relationship between the physical conditional quality scores and the social appraisal scores for the thirteen study blocks. The main physical and social findings for each study block is also mentioned at the end of this chapter, according to the final appraisal score in ascending order.

8.1 Final Appraisal Scores:

On the basis of the ranking techniques used in the physical and social appraisals of this study (see chapters 4 and 6), table 8-1 shows the physical conditional quality scores and the social appraisal scores for the thirteen study blocks. In addition to the final appraisal scores for each block, which were derived from the integration of the physical and social appraisal results. A very simple mathematical relationship was used in this integration, due to the equal importance of each appraisal technique and the difficulty of comparison between them. So, the simple average score was adopted for each case study block by adding the physical conditional quality score to the social appraisal score and dividing the result by two (i.e. The final appraisal score = physical conditional score + social appraisal score / 2).

The final appraisal scores range between 70.6% and 55.2%. The highest final appraisal score was for the Essington House, which means this block was the best in

TABLE 8 - 1:

FINAL APPRAISAL SCORES (%) OF THE 13 CASE STUDY BLOCKS

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	Physical Conditional Quality Score (%)	Social Appraisal Score (%)	Final Appraisal Score (%)	Ranking Order for Remedial Action
1.	LAPWORTH HO.	13	19	64.0	55.0	59.5	3
2.	DURHAM HOUSE	20	18	67.0	52.3	59.7	5
3.	STOKESAY HO.	11	23	64.0	49.4	56.7	2
4.	NETLEY HOUSE	11	23	67.0	60.1	63.6	10
5.	WHEELDON HO.	11	17	74.0	64.9	69.5	12
6.	WESTON HOUSE	13	21	69.0	55.3	62.2	7
7.	WOBURN HOUSE	13	18	71.0	50.0	60.5	6
8.	BALDWIN HO.	15	20	72.0	54.1	63.1	9
9.	ESSINGTON HO.	15	19	75.0	66.2	70.6	13
10	DORSET TOWER	18	17	66.0	53.1	59.6	4
11	NORMANSEL TO.	18	16	62.0	48.4	55.2	1
12	SALISBURY TO.	20	20	72.0	59.1	65.6	11
13	BARRY JACKSON	20	16	71.0	54.7	62.9	8

the general condition (physically and socially) among the thirteen case study blocks. The lowest final appraisal score was for Normansell Tower, and it was the worst in the general condition among the case study blocks. This means that Normansell Tower has priority in any remedial action which might be taken to the thirteen study blocks. The final scores for the other eleven study blocks ranged between 69.5 % and 56.7%, as shown in table 8-1, which also shows the age and height of each case study block.

The graphical comparison between the three scores (physical, social and final appraisal scores) for the thirteen blocks shows no intersection between them, as shown in figure 8-1. The blocks with high physical conditional quality scores had high social appraisal scores as well, the reverse is also true, except for two cases (Durham Tower and Woburn House), where their physical conditional scores are not proportional to their social appraisal scores. Figure 8-1 shows that, generally the physical conditional scores are higher than the social appraisal scores for the thirteen case study blocks. This was predictable, due to the differences in the scales

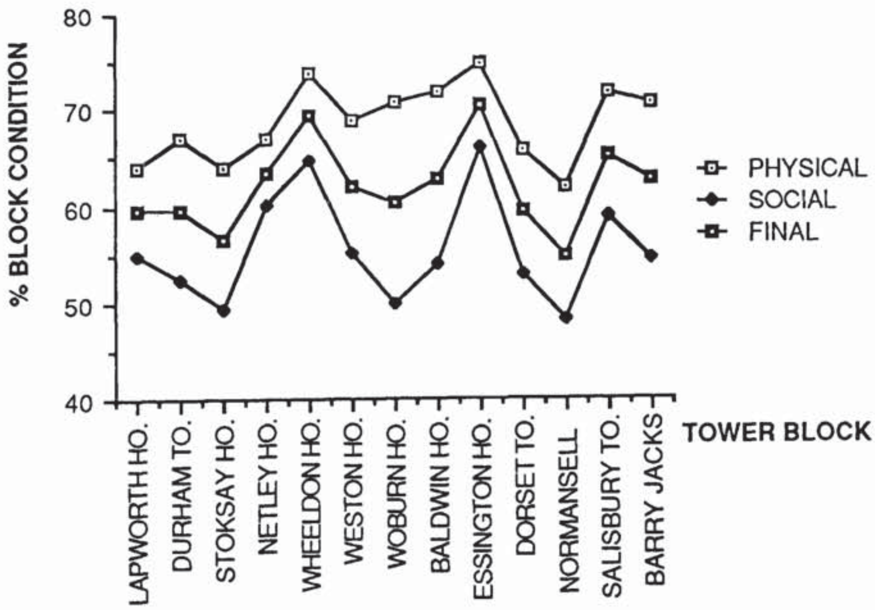


Figure 8-1 The physical, social and final appraisal scores for the thirteen case study blocks.

used in the physical and social appraisals and the normal reaction of people in such matters tends to understate the real situation.

The relationship between the conditional quality scores and the social appraisal scores for the thirteen study blocks was tested statistically using ANOVA. The statistical result proved that there was a significant relationship between the physical conditional quality and social appraisal scores ($p = 0.007$). Further, the relationships between the final appraisal score and the age and height of the block was tested statistically, using the multiple regression method. The statistical results showed that there was no significant relationship between the final appraisal score and the age of the block ($P = 0.516$) or the height of the block ($P = 0.439$).

The final appraisal scores of the thirteen case study blocks is shown in ascending order in figure 8-2. In general, this means that the best two blocks were Essington and Wheeldon Houses and the worst were Normansell Tower and Stokesay House.

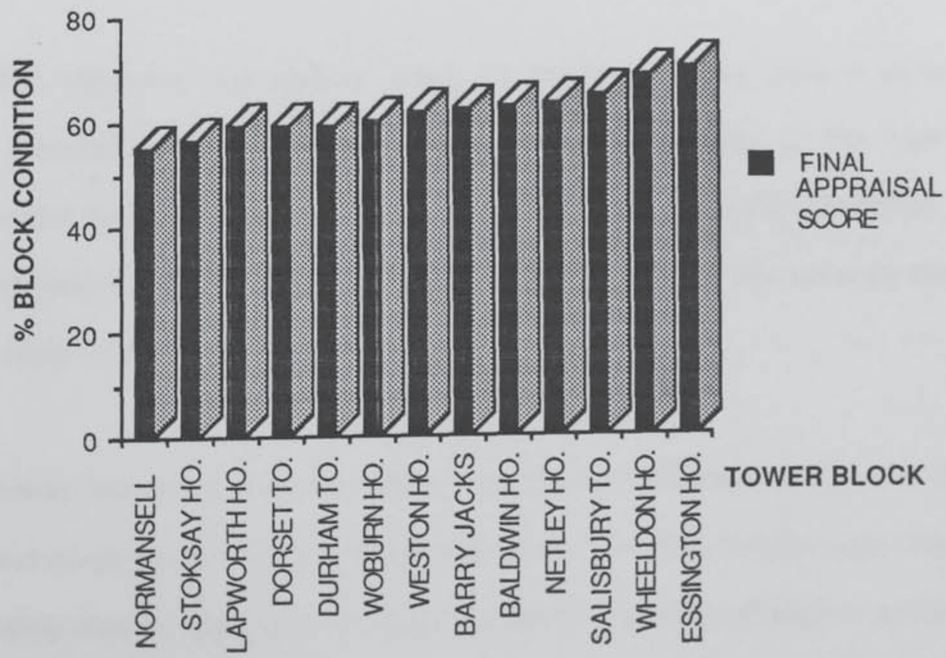


Figure 8-2 The ascending order of the final appraisal scores for the thirteen case study blocks

8.2 Blocks Ranking and the Main Findings in Each Study Block:

The block which has the priority in any remedial programme is very clear now, and the ranking of the thirteen study blocks according to this priority was as follows:

1. Normansell Tower;

This block is one of the newest Bison large panel blocks in Birmingham, it is only 16 years old with 18 storeys. The physical appraisal survey indicated that the Normansell Tower was structurally good with no evidence of structural failure. In the finishes category, CAN UK's report shows a relatively high incidence of multi-directional cracking in the external tile cladding (49 instances). The technical report showed 61 of the concrete panels needing attention (due to corrosion of the ties between the inner and outer leaves of the exterior panels). This combined with the study appraisal indicates that the external cladding is suspect and requires a degree of remedial work.

With regard to the internal fabric of the block, there were a variety of less serious physical defects such as; inadequate security systems for the main door and the lift motor room, poor standards of decoration throughout the communal areas, old lifts, deteriorated internal fixtures and the back main door was severely damaged as can be seen in plate 8-1.

Inside the dwellings, the major recurrent problems were those concerning damp and condensation which seemed especially prevalent on the upper floors. These were mainly due to defects in the central heating system, ventilation system and the insulation of the block. Around half of the respondents were bothered by noise, kitchen and bath fittings and the form of ventilation in the dwelling. Finally, more than 36% of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

Plate 8-1 The damaged back door in the Normansell Tower

According to the biographical data of the social appraisal, around 58% of the respondents were less than 40 years old, and only 18 % were elderly people (65 years or over). So, Normansell Tower block represents one of the mixed age blocks. Of the total block respondents, 57% were single and living alone. Around 36% of the respondents were unemployed and only half of this percentage were retired. A little more than 20% of the respondents were employed. There were a limited number of children in the block.

The most significant complaint factors in Normansell Tower were the main security system (86% of the respondents were dissatisfied, most of them strongly dissatisfied), insulation, ventilation, refuse chute-room, communal areas, central heating system, lift, the safety (i.e. the lack of a feeling of security), vandalism, privacy and childrens' play facilities.

2. Stokesay House;

This block is one of the oldest Bison large panel blocks in Birmingham, it is 23 years old and only 11 storeys high. The block itself is one of a group of five eleven storey blocks which were maintained by two caretakers living in adjacent blocks.

The physical appraisal survey indicated that the Stokesay House was structurally good with no evidence of existing structural failure, but was in poorer structural condition than Normansell Tower. There was evidence throughout the height of the stairwell of cracking between the concrete panels and also much cracking of the internal wall coverings in the chute rooms and drying areas on most floors. In other words, the main structural defects of this block were associated with the joints and internal wall panels.

In the finishes category, the CAN UK report shows the worst problems of the external fabric to be concerned with the spalling of concrete and subsequent exposure of the reinforcement-bar (re-bar, 54 cases). This was not in evident from the ground level. The technical report showed some of the concrete panels as needing attention (due to corrosion of the ties between the inner and outer leaves of the exterior panels). Throughout the block, the communal areas generally were in good condition with some landings having carpets and plants in tubs supplied by the residents. The lift does not serve the 10th floor which is an inconvenience for the older inhabitants who are characteristic of this block.

Within the dwellings themselves, the major problem was moisture below the windows. This was evident from the peeling wall coverings and growth of black mould within the dwellings and could possibly be due to the split/perished mastic sealants mentioned as a general comment in the CAN UK report. More than 35 % of the respondents preferred the same layout of the dwelling, in a low-rise context.

According to the biographical data of the social appraisal, around 55% of the respondents were 65 years or over, and only 29 % were less than 40 years old. So, Stokesay House block represents one of the mixed age blocks, but with a predominantly aging population. Of the total block respondents, the percentage of residents who were couples was greater than the percentage of singles. Around 30% of the respondents were unemployed and about the same were retired. There were a limited number of children in the block.

The most significant physical and social defects in Stokesay House were the insulation (71% of the respondents dissatisfied), ventilation (around 60% of the respondents dissatisfied and as shown in plate 8-2, there were many ventilation opennings have been covered by a layer of mould), front and rear main doors of the block, communal areas (less than 25% were satisfied), the main security system (89% of the respondents dissatisfied, most of them strongly dissatisfied), the central heating system (around 50% dissatisfied with 41% not using the central heating system in the dwelling), the lifts (less than 50 % were satisfied), the safety (i.e. the lack of a feeling of security), the vandalism and childrens' play facilities.

Plate 8-2 Mould layer covered the ventilation duct opennings in the Stokesay House roof

3. Lapworth House;

The block is situated in the inner area of Birmingham City, it is 19 years old and 13 storeys high. It is one of the Fram large panel blocks and part of a mixed development containing many tower blocks with an apparently high population density area which may have social disadvantages for the residents.

The physical appraisal survey indicated that Lapworth House was structurally good with no evidence of existing structural failure. It seemed to be in poorer structural condition than the above two blocks. The external load bearing panels showed some evidence of distress. This could be seen throughout the block with cracking at the panel intersections, the worst cases being at the joint between floor units and external load bearing panels, see plate 8-3. This constitutes not only a potential structural risk but also allows a path for the spread of smoke and flame in

Plate 8-3 The joint between floor units and external load bearing panels Lapworth House.

the event of a fire in the chute rooms and adjacent corridors, and also from dwelling to dwelling.

Externally, the main finishes problems highlighted in the CAN UK report were those of vertical cracking of the tile panels (52 cases) and the split/ perished mastic sealants to window frames and panel joints throughout the block. The technical report showed some of the concrete panels needing attention (due to corrosion of the ties between the inner and outer leaves of the exterior panels).

Throughout the block, the communal areas generally were in a moderate state of repair with reasonable standards of decoration throughout. New lifts had recently been installed, but the entrances at each floor were often inadequately lit. Some of the caretaker's service cupboards had been broken open and were being used as storage for electrical contractors waste causing a potential fire hazard.

Within the individual dwellings, the main concern of the residents was the damp, condensation and poor heating facilities. The block initially had been installed with underfloor electric heating which is not used and the small electric bar fires additionally installed were incapable of keeping the living room warm. Secondary glazing was provided on some elevations as a barrier to noise pollution from the major trunk road outside. Twenty five percent of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

According to the biographical data of the social appraisal, 75% of the respondents were between 41-64 years old, with the remainder of respondents being equally less than 40 years old or 65 years or over in approximately equal proportion. So, Lapworth House block represents one of the mixed age blocks. Of the total block respondents, the percentage who were couples was double of the percentage of the single householders. Twenty five percent of the respondents were unemployed and about the same were employed, most of the other were retired. There was a very limited number of children in the block.

The most significant physical and social defects in the Lapworth House were sound insulation (50% of the respondents dissatisfied), ventilation, the front and rear main doors of the block, the roof, communal areas, the main security system (50% of the respondents strongly dissatisfied), the central heating system (around 90% dissatisfied and nobody used the central heating system of the block), lifts (50% of the respondents strongly dissatisfied), the electricity installation, the safety (i.e. the lack of a feeling of security), vandalism and childrens' play facilities.

4. Dorset Tower;

The block is one of the newest Bison large panel blocks in Birmingham, it is just 17 years old and 18 storeys high. The physical appraisal survey indicated that Dorset Tower was structurally good with no evidence of structural failure or possible future failure. In the finishes category, the cladding panels appear in relatively good condition. CAN UK report notes many small, hairline cracks in the panels and small areas of re-bar that are exposed. These faults were likely to be connected with the Engineer's Department Technical Report which shows that 84% of the cladding panels are in need of attention. The CAN UK report also, combined with the study appraisal indicate that the metal window surrounds are rusting below the sills, and the doors have been removed from the air vent housing on the roof of the block.

At the time of the physical appraisal survey, the communal areas of the block were in the process of being repainted and carpeted. The lift does not serve the top floor which forces the residents to climb the last flight of the stairs. The dwellings had installed electric ducted air central heating which was used by the residents in varying degrees, due to the cost and the inefficiency problems, as shown in plate 8-4. Again, cases of damp and condensation were the main problems encountered by the residents. Only 10 % of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

Plate 8-4 The inefficiency of the central heating system in the Dorset Tower block

According to the biographical data of the social appraisal, 50% of the respondents were less than 40 years old, and around 20% were 65 years or over. So, Dorset Tower block represents one of the mixed age blocks. Of the total block respondents, the percentage of the single householders was more than 55%. Forty percent of the respondents were employed and around 30% were retired. There were a very limited number of children in the block.

The most significant physical and social defects in Dorset Tower were insulation, ventilation (around 65% of the respondents dissatisfied), the front and rear main doors of the block, the central heating system (95% dissatisfied and around 75% of the respondents did not use their central heating system in the dwelling, see plate 8-4), the lift (45% of the respondents were satisfied), the safety (i.e. the lack of a feeling of security), vandalism and childrens' play facilities.

5. Durham Tower;

The block is one of Birminghams' Fram large panel blocks, it is 18 years old and of 20 storeys height. The block has no resident caretaker, general cleaning and minor repairs being carried out by the caretaker who lived in an adjacent area. The physical appraisal survey indicated that the Durham Tower was structurally good with no evidence of existing structural failure.

In the finishes category, the CAN UK report shows the worst problems on the external fabric to be concerning the spalling of concrete and subsequent exposure of re-bars. From the ground, it was possible to see evidence of spalling of the panel edges. One large fragment which had apparently fallen off the block was 2" in diameter and showed very poor compacting in the connections of the pre-cast panels. The technical report showed some of the concrete panels needing attention (due to corrosion of the ties between the inner and outer leaves of the exterior panels).

Throughout the block, the entrance lobbies, lift landings and stairways were in very poor condition with broken light fittings and graffiti. Also, the door to the roof has been broken open. The steps outside the block (in the rear) were in a state of disrepair with a slab missing and potentially dangerous. Within the dwelling, the main concern of the residents was damp penetration, both from the external environment and the dwellings above (accidental flooding). Damp was particularly prevalent below the window sills, along the outer wall/ceiling interface, and the external corners, especially on the upper floors. Forty percent of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

According to the biographical data of the social appraisal, 30% of the respondents were less than 40 years old, and around the same percentage were 65 years or over. Consequently, Durham Tower represents one of the mixed age blocks. Of the total block respondents, the percentage who were couples was greater than the percentage of singles. The percentage of employed, unemployed and retired were about the same, 30% each. There were no children in the block.

The most significant physical and social defects in Durham Tower were sound and thermal insulation (around 60% of the respondents dissatisfied), ventilation (around 60% of the respondents dissatisfied), the external cladding, the front and rear main doors of the block, internal doors and external windows, communal areas (70% dissatisfied), the main door security system (100% of the respondents dissatisfied, 90% of them strongly dissatisfied), the central heating system (around 60% dissatisfied and 70% of the respondents did not use their central heating system), the lift (50 % dissatisfied), noise, the safety (i.e. the lack of a feeling of security, 90% dissatisfied), the vandalism (100% dissatisfied) and the problems made by children living around the block.

6. Woburn House;

The block is one of Birminghams' Bison large panel blocks, it is 18 years old and 13 storeys in height. The block is situated in a mixed development estate, comprising high, medium and low-rise dwelling units. The block has no resident caretaker, general cleaning and minor repairs being carried out by the caretaker of an adjacent block. The surrounding area contains only one small grocers shop which compels residents to travel into the city centre for shopping facilities.

The physical appraisal survey indicated that the Woburn House was structurally good with no evidence of existing structural failure. In the finishes category, the CAN UK report highlights problem areas as being both hairline cracking of the panels and many areas of re-bar exposed. The technical report showed some of the concrete panels needing attention (due to corrosion of the ties between the inner

Plate 8-5 Exposed reinforcement bar in the parapet of Woburn House

and outer leaves of the exterior panels). On the roof there is slight ponding with one section of the concrete roof tiles having a water proof bitumen coat. Along the parapet wall sections of re-bar are exposed, as shown in plate 8-5.

Throughout the block, the standards of the decoration are generally adequate with evidence of recent repainting of the communal areas. On the ground floor, entrance lobby wall tiles have apparently been fixed over a movement joint with the result that they have cracked along the length of the joint. The lifts have yet to be replaced/refurbished and are consequently in a poor condition. Also the top floor is not served by the lifts which forces the residents to use the last flight of stairs.

The heating system within the dwellings is of the electric ducted air type with the large unit situated in the living room. This was used by the residents to greater or lesser degrees, some claiming high running costs yet others claim it to be no different to previous combined gas/electric bills. Damp and condensation problems arise again, but to a lesser degree than some previous study blocks. More than 40 % of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

According to the biographical data of the social appraisal, around 60% of the respondents were 65 years or over, and only 25% were less than 40 years old. So, Woburn House block represents one of the mixed age blocks, but with a predominantly aging population. Of the total block respondents, the percentage of who were couples was half of the percentage of singles. Around 42% of the respondents were retired and about the half of this percentage were unemployed. There were a very limited number of children in the block.

The most significant physical and social defects in Woburn House were insulation (50% of the respondents dissatisfied), ventilation (around 60% of the respondents dissatisfied), doors and windows, the front and rear main doors of the block (around 92% dissatisfied, most of them strongly dissatisfied), communal areas (nearly 60% were dissatisfied), the main security system (100% of the respondents dissatisfied, 75% of them strongly dissatisfied), the central heating system (nearly 70% dissatisfied and about 60% of the respondents did not use their central heating system), the lift (around 30 % of the respondents were dissatisfied), noise, the health and shopping facilities in the estate, the safety (i.e. the lack of a feeling of security), vandalism (more than 90% dissatisfied) and childrens' play facilities.

7. Weston House;

The block is one of the older Bison large panel blocks in Birmingham, it is 21 years old and only 13 storeys in height. The block itself is one of a group of three thirteen storey blocks. The block has no resident caretaker, general cleaning and minor repairs being carried out by the caretaker of an adjacent block.

The physical appraisal survey indicated that the Weston House was structurally in good condition with no evidence of failure. Again, in the finishes category, the external cladding appears to be in a good state of repair yet the more in depth CAN UK report highlights some problems with the mosaic tiled panels. There, the different report format shows the problems covering vertical, horizontal and multi-directional cracking of the external panels as one figure (80 cases). The technical report showed some of the concrete panels needing attention (due to corrosion of the ties between the inner and outer leaves of the exterior panels).

Throughout the block, the general standards of the communal areas were satisfactory. The lifts have not been replaced since erection of the block in 1967, and the lift entrances on each floor were bleak and poorly illuminated. The public phone box on one of the middle floors had been vandalised and was consequently out of order.

Plate 8-6 The dwelling damp evidence in Weston House block

The dwelling is supplied with an electric underfloor central heating system which, once again, was not used. The major problem was water condensation below the window frame. This was evident from the peeling wall coverings and growth of black mould within the dwellings and could possibly be due to the split/perished mastic sealants mentioned as a general comment in the CAN UK report, see plate 8-6. Nearly 35 % of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

According to the biographical data of the social appraisal, around 20% of the respondents were 65 years or over, and nearly 45 % were less than 40 years old. Consequently, Weston House represents one of the mixed age blocks. Of the total block respondents, the percentage of who were couples was slightly less than the percentage of singles. More than 20% of the respondents were employed and about the same were unemployed, the percentage of the retired was the double. There was a very limited number of children in the block.

The most significant physical and social defects in Weston House were sound and thermal insulation (nearly 60% of the respondents dissatisfied), ventilation, doors and windows, the main security system, the central heating system (nearly 80% dissatisfied and about 70% of the respondents did not use their central heating system of the block), the lift (around 20 % dissatisfied), the safety (i.e. the lack of a feeling of security), vandalism (more than 50% dissatisfied) and childrens' play facilities.

8. Barry Jackson Tower;

The block is one of the newest Bison large panel blocks in Birmingham, it is only 16 years old and 20 storeys in height. Barry Jackson Tower was occupied in 1972. The physical appraisal survey indicated that the Barry Jackson Tower was structurally in a very good condition with no evidence of existing structural failure.

The major finishes problem which faces the city council is the mosaic tiles which have come loose in places, which are providing a safety problem. Indeed some tiles have become dislodged from underneath the windows, and the City Housing

Department has been forced to erect scaffold around the bottom of the block as a safety precaution, as shown in plate 8-7. The technical report showed some of the concrete panels needing attention (due to corrosion of the ties between the inner and outer leaves of the exterior panels).

Throughout the block, the communal areas generally were in good condition, where there were no carpeted areas but the stairwells had been recently painted. The original lifts were still in place, and were working adequately. The security system was not working and anyone was able to get in without keys. Generally, the drying rooms were not used though they were kept relatively clean by the caretaker who lived in the low-rise development not far from the block.

Along with the other newer blocks, Gas central heating system has been installed within the dwellings. This is much more cost effective and all the dwellings visited with such a system were heated to a far greater degree than any of the other older electrically heated blocks (nearly 90% of the respondents used their central heating system). There was little evidence of condensation or damp. Nearly 50% of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

According to the biographical data of the social appraisal, more than 40% of the respondents were less than 40 years old, and only 25% were 65 years or over. So, Barry Jackson Tower block represents one of the mixed age blocks. Of the total block respondents, the percentage of couples (32%) were nearly half of the percentage of single householders (61%). Around 40% of the respondents were unemployed and half of this percentage were employed, most of the rest were retired. There were a number of children in the block.

Plate 8-7 The scaffold to the main entrance of the Barry Jackson Tower

The most significant physical and social defects in Barry Jackson Tower were insulation (nearly 40% of the respondents were satisfied), ventilation (less than 50% of the respondents were satisfied), the front and rear main doors of the block, communal areas (less than 50% were satisfied), the main security system (nearly 70% of the respondents dissatisfied, most of them strongly dissatisfied), lifts (32% of the respondents were satisfied), noise (mainly due to the motorway near the block), the safety (i.e. the lack of a feeling of security), vandalism and childrens' play facilities.

9. Baldwin House;

The block is one of the Bison large panel blocks in Birmingham, it is 20 years old and 15 storeys high. The physical appraisal survey indicated that Baldwin House was structurally good with no evidence of existing structural failure. The roof has recently been resurfaced although there is still evidence of water penetration on the top floor (14th). In the finishes, the more serious problem which affects the external fabric is the cracking of mosaic tiled cladding panels (same as Barry Jackson Tower). The CAN UK report particularly highlighting the vertical cracking of the tiles (193 cases), horizontal cracking of the tiles (29 cases), diagonal cracking (26 cases), hollow areas below the tiled surfaced (65 cases), tiles missing (25 cases) and tiles and mortar removed (23 cases). Therefore, the external fabric of the block requires the attention and remedial work.

Throughout the block, the communal areas generally were in poor condition, the decoration was of a poor standard. In the stairwells, the louvred windows are formed using removable, wired glass which allows vandalism to take place and a possible safety hazard. The dwellings on the 14th floor have been provided with double glazing, yet the underfloor heating is still incapable of keeping the dwellings warm at a reasonable cost. The common two problems of damp and condensation arise again together with the added inconvenience of draughts coming through and around badly fitting balcony doors. Nearly 60% of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

According to the biographical data of the social appraisal; most of the respondents were elderly people and only 25% were between 41-64 years old. So, Baldwin House block represents one of the blocks for elderly people. The majority of the respondents were retired. There were no children in the block.

The most significant physical and social defects of Baldwin House were the insulation (50% of the respondents dissatisfied), the ventilation (around 50% of the respondents dissatisfied), the front and rear main doors of the block, communal areas (around 38% were satisfied), the main security system (nearly 70% of the respondents dissatisfied, most of them strongly dissatisfied), the central heating system (around 50% dissatisfied and 75% of the respondents did not use the central heating system of the block), the lift (nearly 40% dissatisfied), parking facilities, the safety (i.e. the lack of a feeling of security) and vandalism.

10. Netley House;

The block is one of the oldest Bison large panel blocks in Birmingham, it is 23 years old and of only 11 storeys in height. The block itself is one of a group of four eleven storey blocks in an open position with large grassed areas between the buildings. Again, the block has no resident caretaker. The general cleaning and minor repairs being carried out by two caretakers living in adjacent blocks. It is of the same type and age as Stokesay house in Erdington.

The physical appraisal survey indicated that Netley House was structurally good with no evidence of existing structural failure, the main structural defect of this block was with the joints. Externally, the block finishes has a white painted finish to the concrete panels which has deteriorated to give a 'tatty' appearance. Poor maintenance of paint finishes has led to decay of the timber. The CAN UK report shows 22 cases of the re-bar and 22 cases of concrete spalling with re-bar again exposed. Also, the mastic sealants were split and perished throughout the block with evidence of patching.

Throughout the block, the lifts have recently been refurbished with the installation of new control panels. The carriages themselves were the original ones and were consequently dirty and disfigured. The refuse chute rooms were generally in poor condition. The partitions have been severely damaged, see plate 8-8. The residents had covered the louvres to stop the draughts in the corridors. The residents at Wheeldon House had also carried out this modification, but to a higher standard, see rank number 12.

Plate 8-8 The damaged partitions in Netley House block

Within the dwellings themselves, underfloor electric central heating is provided as the primary heating system with an electric bar fire also installed. The effects of damp were in evidence in some dwellings, but perhaps not as frequently as in previously studied blocks. Fifty percent of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

According to the biographical data of the social appraisal, 50% of the respondents were 65 years or over, and only 35 % were less than 40 years old. So, Netley House block represents one of the mixed age blocks. Of the total block respondents, the percentage who were couples was 40% and the percentage of the single householders was 25%. Thirty five percent of the respondents were employed and about the same were retired. There were very limited number of children in the block.

The most significant physical and social defects in the Netley House were insulation (60% of the respondents dissatisfied), ventilation, the front and rear main doors of the block (25% dissatisfied), communal areas (20% dissatisfied), the main security system (30% of the respondents were satisfied), the central heating system (60% dissatisfied and 60% of the respondents did not use their central heating system), noise, the safety (i.e. the lack of a feeling of security), vandalism and childrens' play facilities.

11. Salisbury Tower;

The block is one of the older Bison large panel blocks in Birmingham, it is 20 years old and 20 storeys in height. The block is supplied with 2 full time wardens and one resident caretaker. Due to there being six dwellings per floor, one warden covers up to the 9th floor while the other warden covers 10th to the 19th floors. The block is let under a "maturity block" policy with only the over 40's years old, without children, allocated dwellings. When the block was converted to a Vertical Warden (mature) block, some works were carried out comprising redecoration, carpeting and a degree of re-wiring. It appears that the council policy is to do any necessary work during the upheaval caused, in conjunction with the new letting policy. On the ground floor, a communal area is provided for the use of the all residents as a day centre, see plate 8-9.

Plate 8-9 The kitchen of the communal area on the ground floor of the Salisbury Tower block

The physical appraisal survey indicated that the Salisbury Tower was structurally good with no evidence of existing structural failure. Externally, the finish of the block was perhaps in the worst condition among the thirteen case studies. The CAN UK report for this block shows that the problems were related to the external mosaic tiled cladding panels and cover vertical, horizontal, diagonal and multi-directional cracking as one inclusive item (194 cases). Together with the numerous occurrences of cracking there were also hollow areas (183 cases), tiles missing (41 cases) and tiles removed (33 cases). These defects were visible from the ground level together with what appears to be bitumen patches on some panel edges. The roof had recently been resurfaced yet the roof building have areas of degraded, spalling render.

Throughout the block, the communal areas generally were in very good condition with carpeting and high standards of decoration with some plants in tubs supplied by the residents. The stairwells have opening windows in place of the usual louvres. A pay phone was provided on the 6th floor. The main security system was generally good.

Within the dwellings themselves, the underfloor heating system was supplied which, yet again, was not generally used. On some floors there existed air gaps at the top of dividing walls allowing sound transmission between dwellings and possible paths for spread of fire. Those dwellings on the top floor (19th) showed evidence of moisture penetration from the roof above. This was particularly prevalent at the external wall/roof junction. Nineteenth floor residents also complained of extractor fans which failed to work effectively, transmitting odours from adjacent dwellings. Nearly 40% of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

According to the biographical data of the social appraisal of this block, around 85% of the respondents were 65 years or over, and the rest were between 41 and 64 years old. So, Salisbury Tower block represents one of the elderly people blocks. Of the total block respondents, there were only six couples in the block, while the rest were single householders. Most of the respondents were retired and around 20% were unemployed. There were no children in the block.

The most significant physical and social defects in the Salisbury Tower were the insulation (nearly 40% of the respondents dissatisfied), ventilation (around 50% of the respondents dissatisfied), doors and windows, the central heating system (around 50% dissatisfied and more than 60% of the respondents did not use their central heating system), the lift (less than 30 % dissatisfied), noise, the safety (i.e. the lack of a feeling of security), vandalism (less than 40 % dissatisfied) and nuisance from the children of the estate who lived around the block.

12. Wheeldon House;

The block is one of the best Bison large panel blocks in Birmingham, it is 17 years old and only 11 storeys in height. The building is let under a "maturity blocks" policy with only the over 40's years old, without children, allocated dwellings. The block has been converted to the Vertical Warden Scheme. There was both a caretaker and a warden living in the block. Pullcord alarms were provided in the dwellings of elderly and/or infirm residents. An outstanding feature of the block was that the ground floor storage sheds (normally targets for persistent vandalism) were in full use as valuable residential storage space. Overall, the residents were very pleased with their block, many claiming to be living in "the best tower block in Birmingham".

The physical appraisal survey indicated that the structure of Wheeldon House appeared to be in good condition with no evidence of existing structural failure. In the finishes category, both the CAN UK report and the study physical appraisal showed the external fabric to be in relatively good condition with only a few minor occurrences of cracking and spalling. The City Engineers Department technical report concerning the existence and condition of ties between the external cladding panels and the load bearing wall showed 18 panels requiring attention. Also below some window sills the metal is rusting.

Throughout the block, the communal areas were by far the most well maintained of those encountered in the 13 case study blocks. On the ground floor, there is a communal room provided for the use of the residents as a day centre, see plate 8-13. This contains all those facilities necessary to allow the residents to spend the day here, if desired (i.e. cooker, tea urn, toilets, tables, chairs and arm chairs, etc.). The lift entrances on each floor were fully carpeted with many of them containing artificial flowers provided by the residents. In the corridors adjacent to the chute rooms the residents have fitted heavy duty polythene over the louvres to stop draughts. Unfortunately this would contain smoke within the building during a fire and hence block access to the escape stairs. This was strictly against fire regulations. However the Housing Department did not seem to notice this and should solve this problem, the work has been carried out neatly and the corridors are noticeably warmer.

Within the dwellings, there were very few problems with the Gas central heating system. It is giving good heat output at a reasonable cost. Many of the residents have spent their own money not only redecorating but also installing new bathroom suits with shower, kitchen units and the like. Damp and condensation problems arise again, but to a very lesser degree than previously studied blocks. More than 60 % of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

According to the biographical data of the social appraisal of this block, around 75% of the respondents were 65 years or over, and the rest were between 41 and 64 years old. So, Wheeldon House block represents one of the elderly people blocks. Of the total block respondents, the percentage of who were couples was more than the percentage of singles. With the other marital status, most of the respondents were single householders. Most of the respondents were retired and there was around 20% were employed. There were no children in the block (except one who was nearly 16 years old).

Plate 8-10 The communal room of the Wheeldon House block

The most significant physical and social defects in the Wheeldon House were the insulation (nearly 20% of the respondents dissatisfied), ventilation (around 45% of the respondents dissatisfied), doors and windows, the central heating system (around 50% dissatisfied while more than 90% of the respondents used their central heating system), the plumbing and drainage systems, the health and shopping facilities around the block and the public services on the estate.

13. Essington House;

The block is one of the best Bison large panel blocks in Birmingham, it is 19 years old and 15 storeys in height. The block stands alone, in a pleasant area, approximately 4 miles from the centre of Birmingham. The building is let under a "maturity blocks" policy with only the over 40's years old, without children, allocated dwellings. The block was converted to the Vertical Warden services. There was both a caretaker and a warden living in the block. Pullcord alarms were provided in the dwellings of elderly and/or infirm residents. External garaging facilities are provided with an apparent high take-up rate and little vandalism, as shown in plate 8-11.

The physical appraisal survey indicated that the structure of Essington House appeared to be in good condition with no visible evidence of existing structural failure. In the finishes category, both the CAN UK report and the study physical appraisal note the major defects in the external fabric were spalling concrete with re-bars exposed (22 cases) and the mastic split/perished throughout the block. The external tile panels have previously been bolted into the internal load bearing panels in accordance with the recommendations of the City Engineers Department technical report on the block. Also below some window sills the metal is rusting. On the roof, there was ponding on both the dwelling sections and the gutters with lead flashings removed from the parapet wall/roof upstand interface allowing some water penetration to below.

Plate 8-11 External garaging facilities in the Essington House

Throughout the block, the communal areas generally were in very good condition with carpeting and high standards of decoration with some plants in tubs supplied by the residents. On the ground floor, there is a communal room provided for the use of the residents as a day centre.

The block has recently been supplied with new lifts and all lift entrance lobbies are carpeted throughout. The top floor (14th) is not served by the lifts and consequently the residents have to climb the last flight of stairs to their dwellings, which caused many complaints, mainly due to the occurrence of rain and snow blowing into the stairwell through apparently badly designed louvres and making the stairs very slippery, especially during the winter.

Within the dwellings, the heating system was the main cause for concern according to the residents. Most of them did not use their underfloor heating system. Electric storage heaters were provided but many of the elderly residents did not understand their working and complained of the characteristically slow response of the equipment. Damp and condensation problems were again in evidence, but to a lesser degree than most studied blocks. The residents of the 14th floor were again the worst affected with water penetration from the roof, through wall and below window sills. More than 60 % of the respondents would have preferred the same layout of the dwelling, in a low-rise context.

According to the biographical data of the social appraisal of this block, around 75% of the respondents were 65 years or over, and the rest were between 41 and 64 years old. So, Essington House block represents one of the elderly people blocks. Of the total block respondents, the percentage of couples was nearly the same as the percentage of singles. With the other marital status most of the respondents were single householders. Most of the respondents were retired and there were around 25% employed. There were no children in the block.

The most significant physical and social defects in the Essington House were the insulation (nearly 40% of the respondents dissatisfied), ventilation (around 20% of the respondents dissatisfied), doors and windows, the central heating system (60%

dissatisfied and more than 35% of the respondents did not use their central heating system) and the noise (due to the railway line near the block).

Chapter Nine

THE MAIN ALTERNATIVE SOLUTIONS

This chapter is comprised of a brief consideration of the main alternative solutions, which should be considered before any action is taken. The details of these solutions would need further explanation which has not been possible in this study. The infamous, Ronan Point block is used as a reference in some of these alternative solutions, for more background detail of this block, see Apendix (X).

The basic design decision to be used in the study of large panel blocks is shown in figure 9-1. According to the physical defects and the social problems which were discovered by the physical and social appraisal techniques adopted by this study, there are several main categories of options which have to be considered if multi-storey dwelling study block problems are to be solved. These are as follows:

1. Physical improvement;
2. Social improvement;
3. Re-cycling (dismantling and reuse);
4. Partial Demolition; and
5. Total demolition.

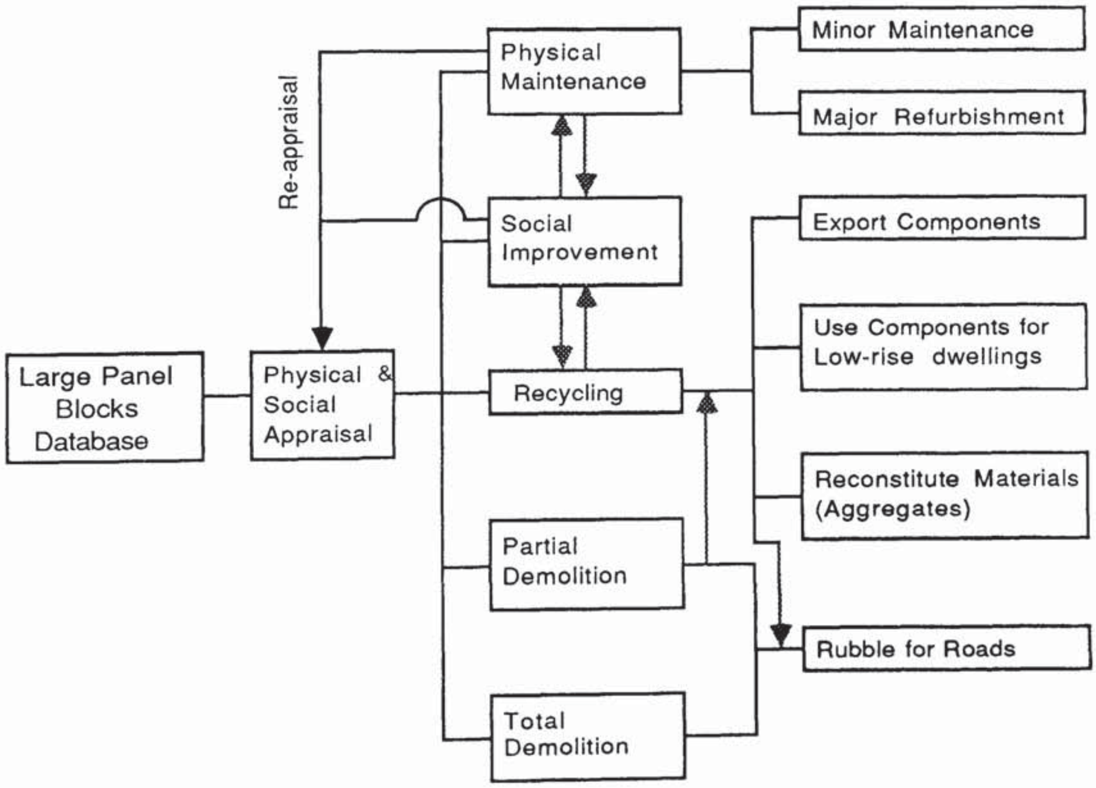


Figure 9-1 **Basic design decision in this study**

These can not be seen individually, rather some of them will have to be applied together in joint solutions. For example, physical maintenance has to be carried out in conjunction with social improvement to significantly improve the level of satisfaction. Likewise, re-cycling solution would only be successful if combined with both physical maintenance and social improvements. Also, partial demolition would be combined with the physical and social improvements for the part left, and re-cycle the panels and materials of the demolished part.

9.1 Physical Maintenance

When considering the physical maintenance of multi-storey dwelling blocks, it is firstly necessary to define the scope of the works. The amount of maintenance work which will be carried out depends mainly on two factors; The "needs" of the block and the amount of money and effort the local authority is prepared to spend on maintenance and refurbishment. Thus, if a particular block is in need of maintenance, the decision on whether any work is carried out will depend on the willingness and financial ability of the owner authorities. This is obviously a poor starting point, where needy study blocks can not be tackled due to lack of funds and there are more needy blocks among the traditional types. Unfortunately, in the present financial climate, it is difficult to foresee the sources of the large sums of money which will be required to tackle this ever increasing problem.

Assuming that funding is available, the following three options which would achieve the physical improvement of a tower block:

1. Minor maintenance:
    a. communal areas only; and
    b. throughout the block.
2. Major maintenance (refurbishment):
    a. internally; and

b. externally.

3. Environmental improvement.

The following subsections describe the above options in more details:

9.1.1 : Minor Maintanence:

This alternative solution comprises two main categories, namely;

A. Minor maintanence to communal areas:

This comprises mainly the improvement of the following communal area categories for the most case study block.

1. Entrance lobbies:

The most important activities to improve the entrance lobbies should be:

a. replacement of damaged areas of wall, floor and ceiling tiles

b. repair/replacement of damaged/missing doors to storage cupboards, meter rooms, caretaker services etc..

c. replacement the broken light units and improvement the entrance lighting.

d. repair/replacement of the inefficient security system at the main door of the block, to increase safety feeling.

e. repainting of deteriorating paint work.

2. Staircase:

The most important activities to improve the staircase should be:

a. replacement the broken light units which constitute an obvious safety hazard in dark stairwells.

b. repainting of deteriorating paintwork with maintenance of crumbling plasterwork and hide the graffitti in this area.

c. repair of the louvred ventilation windows present in most study blocks. Where louvres are of wire reinforced glazing. They are often broken or missing units which shoud be replaced with a more durable material.

3. Lift(s) landings:

The most important activities to improve the lift(s) landings should be:

a. repair of louvred windows and glass partitioning where required.

b. replacement/repair of damaged doors and door furniture, particularly "self-closing" equipment.

c. repainting of deteriorating paintwork with maintenance of crumbling plasterwork.

B. Minor maintanence throughout the block:

Together with the above activities it would also be desirable to carry out the following maintenance to the remainder of the building:

1. Flat interiors:

a. adjusting doors and general making good of other minor defects (eg. mastic around kitchen sinks and baths).

b. it is evident in those blocks containing Electric Storage heating systems that many residents do not understand how to best utilise them and consequently become dissatisfied with the block as a whole. A simple manual showing the use of the Electric Storage heating system produced in collaboration with the social services and distributed to all dwellings

c. this manual may also contain information regarding the requirement for adequate ventilation and the purpose of weep holes in the window frames in relation to preventing condensation.

2. Externally:

a. general maintenance of all roof buildings.

b. general maintenance to the block entrances including the doors, foul vent pipes and roof building claddings.

c. repainting of deteriorating paintwork around window and door frames.

d. replacement/maintenance of mastic sealents in panel joints and around door and window frames.

9.1.2 Major Maintenance (refurbishment):

This could be divided into two main activities according to the position of the defects within the block:

A. Major refurbishment internally:

It comprises many activities which should be carried out as a major maintenance to the building, mainly:

1. Heating systems:

As shown in previous chapters, the Hot Air Electric Storage heating systems in some study blocks are unable to satisfy the tenants daily heat requirements. In some other study blocks, the Underfloor Electric heating mats have partially failed, the details of their construction preventing any maintenance. So, these two heating systems have to be replaced, and other more efficient heating systems could be considered for incorporation in refurbished these blocks; such as;

a. More advanced electric storage heating system, smaller than the existing units, operating on off-peak electricity and installed in the living room, bedroom(s) and hall. Installation of these new units should be accompanied with information on their use, particularly for the elderly residents. Supplementing these units would be one 2 bars electric radiator in the living room and one heat emitting lighting unit in the bathroom, both of these providing immediate heat sources.

b. Where the necessary structural strengthening has been carried out (or could be done) on the block's load bearing leafs, the Gas Fired, low pressure hot water

(LPHW) systems could be adopted. If the dwellings are let on a mature block policy, the boiler house may be located centrally on the roof, ground floor or externally in a separate building (eliminating the risks of progressive collapse due to explosion). The residents would then pay either a contribution to the heating through an increase in their rents which provide a background temperature or with individual controled metering fixed in each dwelling with reasonable fare. This system may give those residents who work during the day more efficient control.

2. Lift(s):

Replacement of those lift carriages and refurbishment of those sets of lifting gear which form part of the original construction.

3. Ventilation forms:

Condensation problems where rife and have to be solved before further refurbishment can be undertaken. The most effective factor is to improve the ventilation forms. To achieve this improvement, windows should be capable of providing small amounts of ventilation. The existing extractor fans operating in the bathrooms should be subjected to a maximum ventilation rate in this area of high moisture production. The kitchens are ventilated by a permament grill located within the built-in storage cupboards. This could be supplemented by the installation of an automatic anti-condensation fan with externally mounted sensors capable of detecting rising humidities.

4. Insulation:

Inadequate insulation ability for heat and sound was a problem in most study blocks. The standard of insulation was apparently very poor and it is much lower than those deemed necessary. Also poor quality control during the manufacturing stage has given rise to discontinuities in the insulating layer and "cold bridging".

To ensure the optimum performance of any heating system and to eliminate the condensation problem, it would be necessary to upgrade the insulation standards. Full and sill height external walls may be upgraded by the addition of a high grade internal lining with a 50mm. insulating layer. This would inevitably be used for concealment of services and would hence require careful detailing to avoid "cold bridging". Alternatively this additional insulating layer may be included betwen the external cladding panel and any subsequent "over cladding" units, see section 9.1.2 B.

5. External fixture:

Window units in all blocks are single glazed (with exception of Lapworth House containing secondary glazing on one elevation for noise reduction). Many of the timber sub-frames show signs of decay and hence susceptible to rain penetration. These could be replaced with double glazed aluminium units in pressed aluminium sub-frames. These will be combatting condensation and rain penetration as well as improving overall thermal insulation. These new units should also be capable of providing small opening facilities to allow careful ventilation control.

6. Electrical services:

Electrical services would need to be re-wired if the other refurbishment proposals were accepted as the life expectancy of the blocks would be extended for at least a further 30 years. The lighting units in the entrance lobby, lift landings, stairwells and could be the dwellings should be replaced with redesigned fittings, providing improved standards of lighting, and housed in vandal proof uints in communal areas.

7. Security system:

Nearly half of the study blocks need a new or renewed security system at the main doors. This matter must be taken seriously due to its importance in reducing many social problems, such as; vandalism, safety, graffitti, etc..

8. Kitchen and Bath units:

Consideration should be given to the replacement of sanitary fittings and some kitchen units, especially for the elderly residents. The cost of this would be relatively small compared with the other improvements yet would be of immense value in ensuring tenant acceptability of the whole scheme.

B. Major refurbishment Externally:

Whilst the internal refurbishment of tower blocks has to be carried out to improve the living standards of the dwellings it must not be forgotten that the external envelope also has to be improved. This is just as important, as a permeable external covering will cause damage to internal improvments and result in the block becoming uninhabitable. The following main activities could take place as an external refurbishment for the block:

1. Mastic sealants:

Externally cracked/perished mastic sealants of panel joints and window surrounds should be raked-out and replaced with a two-stage polysulphide sealant. This would prevent the majority of the cases of moisture penetration encountered in some of the blocks studied. Where a baffle system is employed at panel joints (with a drained joint) a different answer would have to be found, with careful consideration of the original design to prevent the build-up of moisture in open joints.

2. Windows:

Essential refurbishment for windows and frames should be considered. Double glazing could be used to reduce the condensation, mould growth and losses in the thermal mass of the buildings. Also, it could increase the efficiency of the used heating systems and consequently the level of satisfaction.

3. The Cladding:

There were many cladding units in poor condition on many blocks, with spalling of mastic tiles and concrete panel edges together with the exposing of re-bar. A clear cellulose type coating capable of protecting the deteriorating cladding from further exposure to the elements. It is one of the alternative solutions that could be considered for this problem. This would also act as an adhesive, holding individual mosaic tiles in postion. Unfortunately such a solution would be prone to loss of adhesion due to moisture trapped within the semi-saturated concrete. Also, where large areas of mosaic tiles are becoming debonded any relatively thin covering would be unable to resist the greater induced stresses.

Another solution, which has recently been adopted for some tower blocks [63], is the "over cladding" of the entire structure. Over cladding is carried out once the very worst defects have been repaired and generally designed as a "sealed system" intended to exlude completely the passage of the water (the alternative being a "rain screen" which allows water penetration to a controlled extent). Over cladding materials include colour coated steel or aluminium, glass reinforced cement (GRC) and external grade non-metallic boards. The fixing and joint details have to be carefully designed to suit the degree of exposure experienced at these heights. Also it is generally possible to include the additional insulation required for compliance with the current building regulations (0.6 W/m^2K) between the existing structure and the additional overcladding.

4. The roof:

Many residents on the top floors of some study blocks complained of water penetration from the roof above. These block roofs will require replacing with a system similar to that used on Dorset Tower which comprises of a light coloured reflective surface capable of reducing temperature extremes and hence prolonging the life expectancy of the covering.

9.1.3 Environmental improvement:

Many important activities could help into improvement of the environmental categories in the most of the study blocks. These could be:

1. The surrounding land:

The vacant land should be transformed into a planted area with densely planted trees, giving an "established" look and preventing the residents from walking across it.

2. The lighting:

Improved street light units should be provided in the car parks and around the entrances to the blocks.

3. Children play area:

Some of the respondent's problems were due to the shortage of space for children to play away from the block. These problems could be eased by having a small and pleasant central play area in the estate away from the blocks and/or near the places which parents frequent - shops, clinics, laundrettes, etc.. Some form of enclosure is helpful because then the child knows where he is expected to stay, "you donot go inside this". It also keep out the older boys and their footballs, especially if it is under control. This fencing must be wire or a wall, softened with shrubs alongside, and seats.

9.2 Social Improvement:

The multi-storey dwelling blocks can work more effectively if a greater degree of thought is given to their management and use. High-rise housing should not be considered as a hopeless problem, but as one whose solution will create housing in which people will want to live. Its image obviously has to be altered by better management, maintenance, security, communication with the occupants and understanding of their needs.

This study proved that the elderly people were significantly more satisfied with the block's categories than the younger age group, and the level of satisfaction in the blocks with mix aged of residents (such as; Dorset Tower, Normansell Tower and Durham Tower) was less than the blocks with only one-group of age (mostly elderly people, such as; Essington House, Salisbury Tower and so on.). So, it is proposed that allocations of the younger age group to the elderly people would go some way toward overcoming the conflicting life styles of the different age groups.

Perhaps the most successful solution is the Vertical Warden Scheme (VWS) for the blocks which are occupied by elderly residents[77]. In addition to that various solutions could be employed into those blocks to help into increasing the level of satisfaction among the elderly residents. These could be:

1. an individual tenants association should be formed in each multy-storey dwelling block.

2. persuasion the Housing Committee to let the elderly tenants have all the ground floor rooms for social activities and service. In addition to the general

community room, this could be include a small shop, a laundry, a day care centre, hair dressing, etc.. These could be help in strengthing the residents' relationship and the security of the block, and in reducing the possibilty of vandalism and improved safety of the residents.

3. in conjunction with the health authority, the elderly residents could have got a residental care home (part III) and an infirmary within the block, so they do not have to move away when they need care, especially those blocks far from health centre. This could be shared between many nearby blocks located in the same area. The residental care home centre should be in the centre or biggest block with a day care room in the ground floor of each related block at specific time in the morning.

The most successful solution for the blocks which are occupied by families with children, is to move them to the other types of dwelling (either low-rise buildings or houses). It is proposed that "No child" block policy remains and this embargo must be extended to other multi-storey dwelling blocks which have some families with children.

This sort of dwelling seems unsuitable for the younger age group (single householder)of people. Their level of satisfactions were in the negative side of the used scale and it is very difficult to control their behaviour, as shown in one study block "Dorset Tower". This block is mainly for the younger age group tenants with a very limited number of elderly tenants. It has good security system and many other social facilities. Although of these, the level of satisfaction among its residents was in-between, the number of dwelling vacancies increased and most of the residents preferred other sorts of dwelling (either low-rise dwelling or house). In addition to that, their carelessness could increase the deterioration of the physical condition of the blocks.

9.3 Re-cycling (Dismantling and reuse):

Industrialised system built tower blocks are constructed using a series of pre-cast concrete units bolted together and the joints filled with in-situ concrete. If this filling is capable of being removed without causing excessive damage to the pre-cast panels (the Ronan Point studies showed the filling was a non-compressible grout), and the bolts are subsequently exposed and can be released, then the units could be dismantled with very little damage.

Basically, the study (Bison and Fram) systems are a large panel construction system using load-bearing walls and precast flooring slab units, see Appendix I. If the dismantling decision is made and the units are dismantled carefully with a very little damage, these units could require only minor refurbishment to be as new. The general structural condition of the units investigated before was proved they are sound with the exception of minor instances of poor workmanship [50,53]. So, a high percentage of these units could be reused again, after the minor refurbishment to erect new low-rise dwellings with the same previous layout or with small layout modifications. Either at the same estate, or on another site within the British nation or could be exported to another country with more suitable climate for such construction systems.

The other units which are structurally not sound could be used as reconstituted materials as a coarse aggregates or/and as rubble for the new road or building construction, see figure 9-1. The steel in the units, of course could be reused again in many ways. The good finish and service units could be reused after small refurbishment in new construction developments or as a raw material for the new generation of finish and service units (mainly, the same as the structural units).

This procedure has recently been practised in Sweden where a development of nine, four storeys blocks had become socially obsolescent after about twenty years since their completion. It was decided by the client that one block was to be dismantled and the 107 flats it contained formed into 34 one and two storey terraced houses. The contract involved firstly the breaking out of the mortar filler within the panel joints. This was found to be easier than expected as joints were often debounded due to residues of mould oil. Once the mortar had been removed the phosphor-bronze bolts were revealed, and easily released to allow dismantling of the individual panels. These panels were then returned to the factory where they were originally manufactured and those units which had remained serviceable were refurbished before being returned to the site for reuse in the specially designed new blocks.

It was found that the rates of re-usage of the units were approximately 85% for the floor panels, 80% for the flank walls and less than that for the facade panels. Over the duration of the contract it was also calculated that the value of the units in their new usage accounted for 65% of the cost of their dismantling, transport, refurbishment and re-erction in any new building.

Also, an Austrian example, often quoted, shows that the re-cycling (dismantling / re-erection) procedure can be economically carried out, see chapter 3.3 [103]. Here, in Britain, BRE tests on the Ronan Point concrete panels show that most of them were structurally sound. From the photograph 9-1 and 9-2, it can be seen that the concrete panels have not been removed undamaged from Ronan Point. Though, it could be assured that it was possible to remove them without damaging them. It seems likely that those panels after refurbisment could then be reconstructed in the same format economically.

Plate 9-1 The dismabtled flank walls of Ronan Point

plate 9-2 The dismsantled floor panels of Ronan Point

When considering this particular option for the large panel system of multi-storey dwelling blocks in Birmingham, it would be a very desirable solution in most of the study blocks to dismantle the blocks panel by panel and use the sound ones elsewhere on new, low-rise developments. This is mainly because:

1. physically, it is possible;
2. structurally, it is acceptable. The loads (dead, imposed and wind) will be reduced to less than 30% depending on the heights of the study block and the new low-rise buildings, see partial demolition;
3. Gas Fired central heating could be used, where this study proved that the level of satisfaction with the central heating in the blocks have Gas Fired central heating are much more than those blocks contain other sorts of central heating;
4. no need for lift(s) in the new low-rise development, and the space of it could be used for other purposes;
5. no need for very big ventilation forms;
6. in general, the control of all the maintenance activities will be easier than before with the high-rise blocks;
7. socially, it is possible. The most popular height of the low-rise building in this study it was three storeys. The maximum height for this sort of building could be four storeys to avoid lift(s) using;
8. the dwelling satisfaction was much higher than the high-rise block satisfaction which is shown in this study;
9. the attitude of the people toward the same dwelling layout in low-rise building was good;
10. it could be offered the separation between the conflicting life styles of the different age groups;
11. most physical and social diffeclties for the elderly people will be eliminated;
12. low-rise building is more secure than the high-rise one;
13. the vandalism and un-safety feeling will be reduced; and

14. the economic considerations among the other alternative solutions.

All new buildings should be checked with respect to fire prevention and designed to safeguard against disproportionate structural damage. All joints should be with new design features and be adequately filled to resist the spread of fire and fumes, in addition to their structural abilities.

9.4 Partial Demolition:

Partial demolition options could be as follows:

1. A reduction in the height of the tower blocks;

This has involved in the removal of the upper storeys of the block, to make it low-rise building of less than 6 storeys. The reduction of the block lessens (could be eliminated) some of the physical problems (maintenance of the exteriors and access to the flats by lift etc.), environmental problems (driving rain, lower temperatures, wind etc.) and also the social consequences (isolation, height dissatisfaction, safety etc.) associated with living at higher levels. In the structural view, this also reduces the physical stresses and moments on the lower floors, which should prolong the lifespan of the building. In other words, the block stability would be increased, and less structural work would be required to satisfy the engineering criteria of safety.

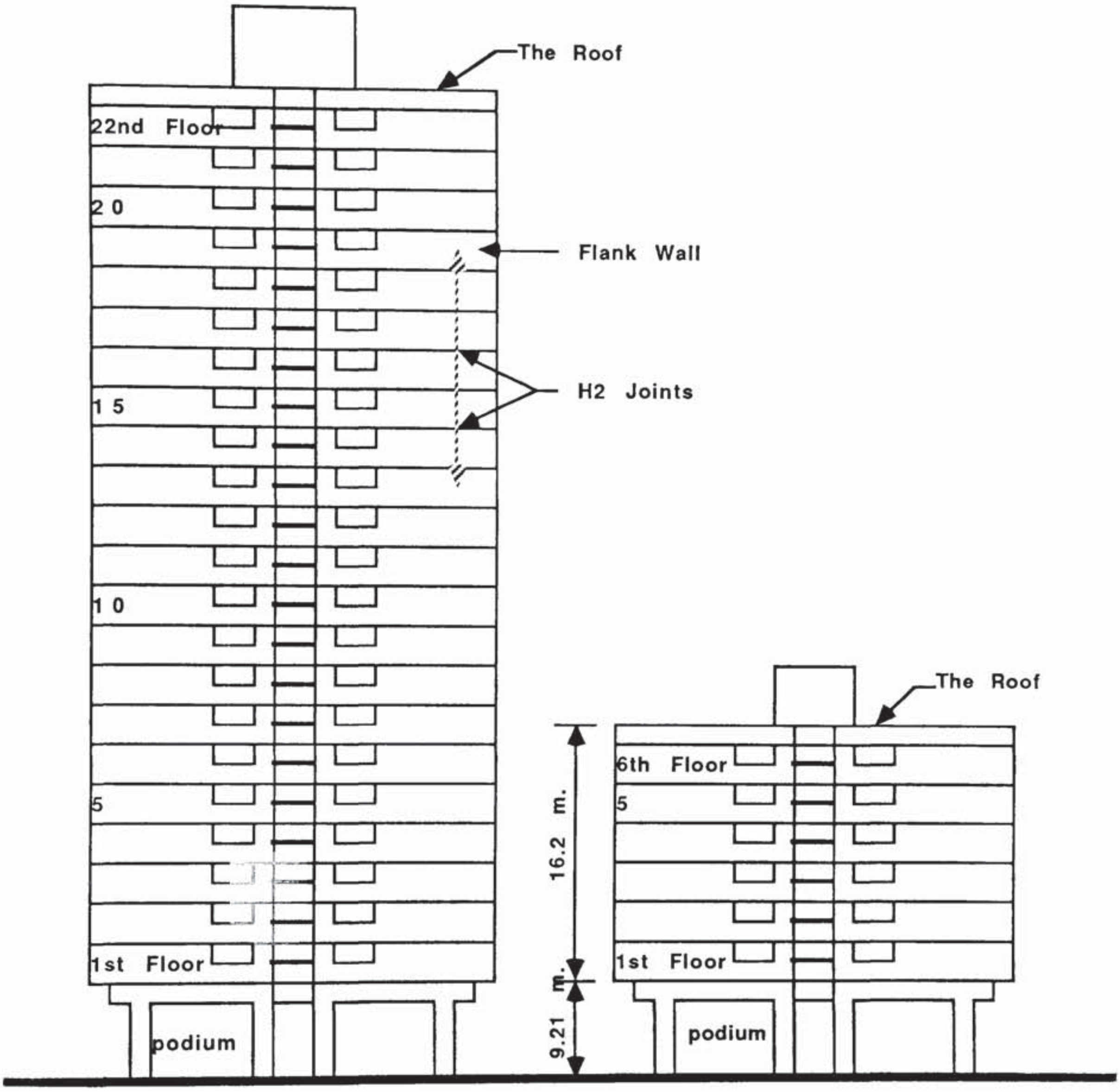
A very good example in this option is Ronan Point again, see Appendix (X). In the BRE report about this block, one of the four possibilities which they recommended for remedial measures to restore adequacy of the structure at lower levels in relation to normal loads was to remove the top eight storeys from the building, thereby reducing the stresses in the joints at the end of the flank walls in the lower storeys to within acceptable levels[53]. This was good alternative solution for this block, but needs little modification. If the top eight storeys were removed, this means that only eleven storeys would be left which represents another high-rise block with the same other physical and social problems. So, the best height should be six storeys or less which was recommended by this study, as shown in figure 9-2. In this new height, the effect of wind loads and the risk of using Gas central heating would be ignored[49].

In more detail, if 16 floors were released from Ronan Point block, the height of the new building would be equal to 25.41 m. (the height of the podium = 9.21m., plus the height of the left six storeys = 16.2 m.), as shown in figure 9-2. In the structural considerations of this alternative solution, the following structural views at the flank wall in the second-floor level, comparing to the structural stress of the original 22 storeys block, would be:

a. Dead loads would be 29% (164.3 KN/m.) of the design existing dead load with the 22 storeys;
b. Imposed loads would be 28% (8.8 KN/m.);
c. The total dead and imposed loads would be 29% (173.1 KN/m.);
d. Base shear stesses due to wind loads will be 30% (0.47 MN) in Y-direction and 29% (0.30 MN) in X-direction, and at 9.21m. height will be 22% (0.30MN) in Y-direction; and
e. Base moments will be 12% (5.97 MN. m.) in Y-direction and 11.7% (3.81 MN. m.) in X-direction, and at 9.21m. height will be 6.6% (2.34 MN. m.) of the existing design moment in case of 22 storeys building.

These were calculated by the same BRE methods used in their Ronan Point report, for more details refer to the reference [53].

In the economic considerations of this alternative solution, the following procedure was done to calculate how much the re-new 6 storeys building could be cost:



a. Side elevation of Ronan Point block

b. Assumed partial demolition (6 storeys)

Figure 9-2 Ronan Point block and its assumed partial demolition

a. Ronan point contains 110 dwellings (5 dwellings in each floor, 3 one-bedroom and 2 two-bedroom dwellings). The costing for refurbishment of the block to bring the dwellings up to reasonable modern standards and be able to assist in the effective management of the block were estimated at £5,724,000 or £52,000 per dwelling, BDP estimation[50]. This included the structural strengthening, essential refurbishments (both were estimated at £28,600 per dwelling), desirable refurbishments, general preliminary costs, the cost of decanting residents and professional fees and supervision. The above costs being as at October 1984.

b. The demolition bid was £ 578,000 or around £5,250 per dwelling.

c. For the left 6 storeys, the costing for refurbishment up to modern standards would be , a maximum of £1.0 million (which in-between the essential and modern standard), and the demolition bid would be around £420,000. The total would be around £1.4 million.

This means that the Ronan Point authority could have a new, good and modern medium-rise building for at least 50 years and with reduced social problems for only about £1.5 million (at the costs of 1987, the year of Ronan Point Demolition). In addition to the output of the upper floor concrete panels and raw materials.

This alternative solution could be considered for some of case study blocks in this study. The top removed floors would be dismantled carefully and re-cycled in other low-rise developments, see section 9.3, and the floors left could be physically refurbished and socially improved for only one age group.

2. Redesign of the dwelling layouts:

This has involved in the redesign of the dwelling and room layouts and possibly the structure. It could be taken the form of joining two dwellings together on the same

same floor or adjacent floors with a staircase. Thus creating a dwelling layout more in-keeping with the socially accepted and traditional housing structure. This would obviously reduce the number of individual dwellings by half yet these dwellings would be larger and better capable of meeting the needs of family occupied blocks.

This alternative solution seems not applicable on the study blocks due to the physical layout of them, where all of these blocks contain only one staircase panel in each floor, and socially it is not acceptable.

9.5 Total Demolition:

This option obviously entails the demolition of the tower blocks achievable by a variety of means (explosive, ball and chain, full dismantle, etc.). The decision on whether demolition is to take place or not can be based on a variety of viewpoints. Firstly, political influences and thoughts are often strongly against tower blocks, for whatever reason and constitute the overriding factors which force demolition of otherwise good blocks. For example, Ronan Point was not necessarily the most suitable block for demolition (see sections 9.3 and 9.4), yet its controversial history made it a politically valid case for demolition.

In the ideal situation, free of political influences the demolition decision (or that of any other alternative solution) should be based first and foremost on physical, social and economic considerations. These have to include the pure financial decisions made between differing options, and also a form of "value engineering" capable of assigning monetary costs to social benefits/detriments.

The actual demolition procedure may be carried out in various ways, depending on the proximity of surrounding buildings, the time period of the contract, the costs and the other environmental considerations. Thus, a tower block may be demolished panel by panel (as was the case with Ronan Point) which is preferred due to many considerations or by the most aggressive use of explosives or impact techniques(ball and chain).

Builders appreciate the true value of materials. For some time contractors have offered to demolish old buildings free of charge, some have even payed to be allowed to have the reclaimed materials. Roof tiles, bricks and lead are of particular value. In these large panel structures, there is a tremendous amount of metal, old heating plant, cable, reinforcement and all the lifting gear. The local authorities should be aware of their hidden assets. There must be continued research into the re-use of old materials. Ronan Point cost more than half a million pounds to demolish. Research may prove that it is possible to dismantle these blocks for much less.

Chapter Ten

MAIN FINDINGS, GENERAL CONCLUSIONS AND RECOMMENDATIONS

This chapter is divided into three sections. The first deals with the summary of main physical and social findings, the second deals with the general conclusions that have been reached and the third makes recommendations for future work which might follow this research project.

10.1 The Summary of Main Findings and General Conclusions

10.1.1 The summary of main physical defect findings:

This sub-section includes a summary of the main physical defects found in the thirteen case study blocks, based on the results of the physical and social appraisal approaches adopted in this study:

1. No deterioration of the structural components was observed, and generally the structural condition of the elements was reasonably sound with the exception of a few instances of poor workmanship.

2. Structural connections were observed to be the main problem. This was in terms of both materials and workmanship. The insitu concrete was poorly compacted, which led to the opening of joints. Mastic sealant became disbonded, thus allowing rainwater ingress.

3. For some blocks, the survey indicated major problems with the roof. The asphalt was found to be in poor condition and was layed continuosly over expansion joints. This defect caused water penetration through the roofs and balconies, which often manifested itself some distance away from the source, having travelled by paths through the structure that are difficult to detect.

4. The external state of the concrete cladding units was good, with relatively few localised incidents of spalling and damage.

5. Ties between the inner and outer leaves of the external wall panels caused serious concern, e.g. there were insufficient ties per panel, or the ties were of unsuitable material, and under certain conditions of wind loading, some cladding components would be overstressed. During the social appraisal study and writing-up time of this research, all suspected items of these cladding components were remedied by inserting bolt ties into them.

6. External Fixtures (doors and windows) were seen to be in poor condition, in most case study blocks. The deterioration of window and door fabrics and the absence or failure of mastic sealant, for instance, led to damp and water penetration.

7. The standard of the internal fittings (i.e. kitchen and sanitary units) appears to vary according to whether they have been replaced since original construction. Generally, the units were in satisfactory condition.

8. In many study blocks, the main entrance doors to the block showed obvious signs of damage and it was apparent that the original door sets were not of sufficiently robust security standard.

9. In most case study blocks, communal areas were often in need of improvement and periodical maintenance by the local authority.

10. The security system in most study blocks was not properly used. Six of the study blocks have completely useless security systems.

11. Five factors influence the extent to which dwellings are prone to condensation. These are heating, ventilation, water vapour generation, thermal insulation and the thermal capacity of the structure[53]. In fact, condensation in the dwellings is caused

by a combination of shortcomings in the prevailing building design, social behaviour and economic factors.

12. Some blocks were shown to have better ventilation characteristics than others. In general, the mechanical ventilation to the internal bathrooms and toilets in the dwellings was found to be below standard and working ineffectively. The level of provision for the ventilation to the communal areas was considered to be quite inadequate.

13. The gas supplies were disconnected from most study blocks (10) covered in the case studies following advice from the Ministry of Housing and Local Government[49], following the Ronan Point disaster.

14. The principal forms of electric central heating system (i.e Electric Underfloor, Ducted Air and Storage Radiators central heating systems), were inoperable in most dwellings of the study blocks, and were the subject of numerous complaints by residents.

15. The appraisal of the pipe work carrying the hot and cold water services in the study blocks have shown these were generally satisfactory, but further checking and testing would be necessary as part of any refurbishment works.

16. The lift(s) in most study blocks had not been refurbished, their carriages were dirty and unpleasant to use. Also, the top floor of many blocks are not served by the lifts.

17. The electrical services were found to be in variable condition, with some communal areas particularly poor. The condition of the installation was generally considered reasonable, having regard to the age and use of the study blocks. Many of

the lift landings are badly lit due to both insufficient numbers of light units and vandalism to those which were provided.

18. The insulation of external walls and roofs should be upgraded to ensure the optimum performance of the heating system and to reduce the condensation and mould problems, and possibly the sound between dwellings.

19. The external yards around most study blocks were often in need of improvement.

20. Garages were occasionally vandalised or simply neglected.

21. In the estates, children play areas and adequate shopping and health facilities were seen to be lacking around most study blocks.

22. The external sound insulation was not adequate in some case study blocks, Noise pollution from motorway, railways and roads contributed to the discomfort some tenants, and there were many complaints of it.

In summary, a combination of obsolescence, lack of planned maintenance, design and construction faults, tenant mis-use, vandalism and so on, have rendered the study blocks in their current state.

10.1.2 The summary of main social appraisal findings:

This sub-section includes the summary of the main social factors were found in the thirteen case study blocks, based on the results of the social appraisal questionnaire:

1. Of the total respondents, the female number were 56 %, the male respondents were slightly over 40 %, whilst nearly 4% made no comment. The average age of the respondents was 54 years.

2. The size of the household was small, around 60 % of the total respondents were single householder. The average number of person per dwelling was 1.51.

3. The number of single respondents living alone was slightly greater than the number of couples. Together they represent nearly two-thirds of the total respondents. Most of the rest of the respondents lived alone, either widowed or divorced.

4. Very limited number of children were found in some case study blocks, only 23 cases in some study blocks.

5. The majority of the respondents were retired (more than 50%). The percentage of employed and unemployed respondents was nearly equal at 19%. The majority of the remainder were housewives.

6. The average length of dwelling occupation was slightly less than ten years, and ranged between one year to 23 years.

7. There was no significant difference (0.01 level) in mean satisfaction level among the respondents according to:

a. size of the dwelling;

b. sex of respondents; and

c. the use of central heating system.

8. The mean satisfaction level of the respondents who preferred to live in the same layout of the dwelling was significantly higher than the mean satisfaction level of those who did not prefer the same layout of the dwelling (p=0.0000).

9. A significant relationship (0.01 level) was found between the level of satisfaction and the following 25 factors, which are in descending order of significance as follows:

a. the estate (r=0.700);
b. the service categories in the block, including heating system (r=0.6478);
c. the vandalism (r= -0.5468);
d. the neighbours (r=0.5173);
e. the security system in the block (r=0.5054);
f. the physical layout of the block (r=0.4839);
g. the lifts (r=0.4800);
h. the communal areas (r=0.4788);
i. the physical layout of the dwelling (r=0.4739);
j. the living room, in general (r=0.4561);
k. the environment, in general (r=0.4481);
l. the insulation (r=0.4362);
m. the noise (r=0.4237);
n. the bathroom and W.C., in general (r=0.4080);
o. the bedroom(s), in general (r=0.3816);
p. the safety (r= -0.3729);
q. the finishes, in general (r=0.3677);
r. the form of ventilation (r=0.3351);
s. the preferred height of the block (r= 0.3204);
t. the kitchen, in general (r=0.3127);
u. the public services in the estate (r=0.3060);
v. the dwelling, in general (r=0.3039);

w. the central heating systems in the blocks (r=0.2821);

x. children play areas (r=0.2686); and

y. the floor number (r= -0.114, on 0.05 level of significant).

This order was according to the statistical analysis of the whole sample (268 respondents) and it can not be assumed to be suitable for consideration on any individual block.

10. No statistically significant relationships ($p < 0.01$ level) was found between the level of satisfaction and the following factors;

a. the length of dwelling occupancy;

b. the ideally preferred form of accommodation; and

c. health problems associated with high-rise living.

11. The level of satisfaction and attitude toward multi-storey dwelling block were not significantly different between the groups in respect of the following variables:

a. marital status;

b. the respondents' occupation;

c. the number of people in each dwelling; and

d. the number of children in each dwelling (limited sample, only 23 cases).

12. There was a statistically significant difference in respondents' satisfaction and attitude among varying categories of age of respondents, where there was a positive relationship (r=0.217).

13. There were no statistically significant relationships (0.01 level) between the ideally preferred accommodation and the following variables:

a. the floor on which the respondents lived;

b. the sex of the respondent;

c. the age of the respondent; and

d. the occupation of the respondent.

14. A significant relationship (0.01 level) was found between the respondents who preferred the same layout of dwelling and the following factors;

a. the age of the respondent; and

b. the occupation of the respondent.

Finally, according to the ranking derived from the integrated appraisal technique (i.e. physical and social) of this study, the ascending order of the thirteen study blocks in terms of their priority in any remedial decision, was as follow:

1. Normansell Tower (the worst study block);
2. Stokesay House;
3. Lapworth House;
4. Dorset Tower;
5. Durham Tower;
6. Woburn House;
7. Weston House;
8. Barry Jackson Tower;
9. Baldwin House;
10. Netley House;
11. Salisbury Tower;
12. Wheeldon House; and
13. Essington House (the best study block).

10.2 The summary of main conclusions:

This section includes a summary of the main conclusions based on the results of the integrated appraisal technique adopted in this study.

An important attribute of the integrated appraisal technique, is that it has proved relatively simple, inexpensive and quick to implement and as a means of obtaining reliable data on the physical and social conditions of multi-storey dwelling blocks of large concrete panel construction. Particularly when it is compared to the alternatives adopted by some local authorities and BRE [38,53,56,57] for the main components. Probably the most significant outcome is that the results of the appraisal method compare very favourably with those produced by existing methods.

Thus, the main advantage of the integrated appraisal technique can be summarised as follows :

a. The method is designed to save time, money and effort.

b. The method provides integrated information that is often not available to those who are working on such multi-storey blocks.

c. The method should aid decision making, for example, for a local authority housing committee.

d. The method is able to provide ranked priority for the multi-storey dwelling blocks.

e. The method can indicate those elements in the greatest need of repair.

f. The data collected may be stored on a database to ensure easy retrieval of the information.

g. The database is organised in a simple format which is easily understood.

h. The method is based on the relative original costs of the units, and is therefore independent of time and inflation (see chapter four).

i. This method will lead to the development of new techniques for appraisal and maintenance management.

The integrated appraisal technique requires expert knowledge in a variety of fields. This approach to the appraisal of blocks is necessary in order to ensure balanced conclusions. The appraisal of all large panel blocks can be completed within a few weeks, providing the work can be undertaken by local and experienced staff.

The five most effective factors that were significantly associated with the residents' satisfaction and attitude toward their multi-storey dwelling block in descending order were:

a. the estate, in general;
b. the service categories in the block, including heating system;
c. vandalism;
d. the neighbours; and
e. the security system of the block.

Of the services categories, the lift(s) and the heating system together in such accommodation were within the first things which sprang to resident's minds when they were asked what they found unsatisfactory in their block. The other important considerations in resident's minds were the security and vandalism of their block and the caretakers' duties. It seems that, particularly in a high-rise dwelling estate, the residents really need to have a tidy block and an estate with good security.

The level of satisfaction and the attitude of the respondents toward multi-storey dwelling blocks was in general varying continually with time, and there was a rapid decline in their satisfaction level and attitude since the beginning of this form of dwelling (at the end of 1960's) until now. The collective results of this study and of others[11,72,73] shows that in the next 10 years and beyond, the level of satisfaction and attitude will be in the negative side of any scale used.

The people whom this type of accommodation does suit are:

a. the couple whose children have already left home, or those who have not yet had a family;

b. a couple in middle-age, say in their 50's without children or perhaps with one offspring approaching majority; and

c. single or elderly couples people under a specific regime, such as VWS.

These are mainly because, the place is easy to clean and control. The young or middle-aged wife can go out to work if she wants to, which in turn offers social contacts, and consequently removing the isolation problems.

It seems that of all the above these people who really "fit" high-rise dwelling life, is that kind of couple who are in the most suited. While, the most suitable accommodation for elderly people is well planned low-rise building. A low-rise dwelling gives them what they want from comfort, easy access, lack of need use a lift and good security. This is especially if the building is under good control regime. In addition to that, it could give an opportunity to divide these elderly people to many social groups, such as single, couple, etc..

The people for whom this type of accommodation is unsuitable were:

a. family with children, especially young ones;

b. single young house-holder; and

c. people of mixed-age group.

In fact, (and this is perhaps the major conclusion) multi-storey dwelling blocks suit the relatively sophisticated, the relatively well-educated, the relatively quite and the relatively well-off person (or couple). In other words, it is the kind of person (or couple) that has got the intelligence to see the risks of living high. But what in general tends to happen is that; the less sophisticated, very poor and deserted people live in this form of accommodation.

It was noticeable that out of the thirteen case study blocks, the three top ranked were under warden control (Essington House 1st, Wheeldon House 2nd and Salisbury

Tower 3rd). So, the recommendation is that Birmingham City Council continue their policy of creating "maturity blocks" and installing wardens, but for blocks whose physical condition is good. Otherwise, those blocks with a bad physical and social conditions could be a waste of time, effort and money, and other alternative solutions (such as re-cycling or partial demolition) would be more sensible.

There were five possibilities for remedial measures to restore the adequacy of these blocks, namely; physical improvement, social improvement, re-cycling, partial demolition and total demolition (see chapter 9). The re-cycling technique or partial demolition could be used in some cases which required more attention, especially those blocks in the first five in the priority positions, namely; Normansell Tower up to Durham Tower, see the ascending order at the end of section 10.1.2.

The major physical and social improvements could be used for the next five blocks in the ascending order, starting from Woburn House up to Netley House, see the ascending order at the end of section 10.1.2. The minor physical and social works were needed for the rest three blocks in the top of the list of case study blocks, namely; Salisbury Tower, Wheeldon and Essington Houses, see the ascending order at the end of section 10.1.2.

In general, early step needs to be taken are to improve community development and good social relationship between, at least, the neighbours in the same block. This is to increase the level of satisfaction and the security of the block.

Finally, consideration should be given to the appraisal of the remainder of the large panel blocks in Birmingham using the proposed appraisal technique in this study, mainly for their priority ranking and to identify the main physical and social defects in each block. Although its applications need not to be restricted to block of any particular construction system.

10.3 Recommendations:

For the further development of this research, the following key points should be taken into account :

1. The gap between the appraisal theory and practical application can be reduced by obtaining other reference material and advice on the cost weighting, maintenance expenditure and all other block details.

2. For the social appraisal, the attempt must be to forecast the nature of society in the next decade, which the new appraisal solution might serve.

3. In the social appraisal, future research should be conducted with residents of multi-storey dwelling blocks and others in different forms of accommodation, to compare their attitudes in relation to this form of accommodation.

4. The analysis of possible solutions which are mentioned in chapter nine, must be in detail and be predictive of the future need, and not simply consider the remedial works required now. An economic appraisal technique should be created to test these alternative solutions on each case study block.

5. In any solution, if maintenance is considered the most appropriate option, a new column may added to the appraisal form. This column would be called "cost of maintenance" and/or "repair". It would be necessary with such an option to go through the method again and estimate the maintenance cost. This may result in yet another solution, if the costs are shown to be too high.

6. Due to the structural appraisal results, the new solution option for large panel blocks must be carefully studied in detail. This is the re-cycling concept, which has recently been undertaken in Europe, and proved its economy[103].

7. Further investigations on the economic and socio-political appraisal approaches should be added to the integrated study appraisal for more alternative solution of each LPS block could be suggested.

8. An Expert system approach could be adopted in the case of integration of the physical and social results, and could be used in the new economic and socio-political appraisal techniques.

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APPENDICES

Appendix I

Bison Wall Frame (WF) System

I.1 The evolution of the Bison WF system:

Concrete Limited started to manufacture precast concrete floors in 1919 [28]. This was one of the world's first attempts to produce a standard precast concrete unit which would be sufficiently adaptable to be used in any type of building, regardless of size or amount of repetition. For the trade-mark, the name "Bison" was chosen as representing speed and strength. In 1951, it became clear that the use of cranes on building sites made possible the handling of far larger units, so the Company introduced the "Bison Wide Slab", increasing the maximum width from 14 in. to 7 ft 6 in., and these units had been the basis of all their development for multi-storey dwelling blocks.

In 1956, the first nine-storey dwelling blocks were constructed using these components namely, wide floor slabs with precast concrete beams and columns. It was soon realised that it was more economical to provide concrete walls than a system of beams with infill walls built afterwards, so beams and columns were progressively eliminated and wall panels put in their place. In 1959, the new techniques for finishing concrete surfaces made concrete external walling acceptable, so eliminating the slow processes of brick cladding from scaffolding. The first large contract completely to eliminate beams, columns, brickwork and scaffolding was constructed in 1961 at Barking [29].

Basically, the Bison WF system was a large panel construction system using load-bearing wall panels and precast flooring slabs. It was the first of its kind in Britain. To be effective the company had five factories throughout the U.K., each with its own organisation for design, delivery and erection on site.

Bison Wall Frame (WF) System was specifically designed for tower blocks of flats. Normally the blocks were between eight and twenty storeys in height, with four, six or eight dwellings per floor. The size and number of rooms in individual dwellings were varied from block to block, ranging from those conforming to the minimum requirements of the Ministry of Housing and Local Goverment, up to the luxury standard of the better types of private development [29]. The treatment of the elevation is similarly variable. In every case standard Bison components were used.

I.2 The Main Bison Components:

Each dwelling used the following specialized units:

1. Staircase castings:

These were made in half flights and the tread surfaces were already incorporated at the factory. The staircase nosing units were fitted into the staircase housings at the site.

2. The liftshaft and stairwells:

These wells were large boxes without lids and bottoms and were cast in one single piece in three-storey heights to accommedate lift installation or staircase units.

3. The bathroom and toilet:

these heart units were in the form of one single unit which weight about 7 tonnes. This casting includes walls, floors, ceiling, the airing and drying cupboards, ducts for plumbing and ventilation shafts. The walls and ceilings were ready for painting.

A standard two-bedroom dwelling, for example used the following prefabricated concrete components:

a. five internal walls;
b. five external wall components;

c. seven floor components; and

d. one bathroom and toilet component;

Add for access:

a. two half flights of stairs;

b. three liftshaft housing units;

c. three staircase housing units;

d. five corridor flooring units; and

e. one refuse chute unit.

That is, 14 access units divided between four dwellings, or three and a half units per dwelling. The number of units thus required per dwelling was 21.5, see figure I-1.

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Figure I-1 The components of the standard Bison two-bedroom dwelling

I.3 Erection:

A conventional foundation was built and the first course of wall units was erected upon this by simply being laid end-on without using either tie-down irons or rods. The external walls consist of an internal 6 in.-thick concrete structural leaf, a layer of expanded polystyrene and a 3 in.-thick leaf of non-loadbearing facing concrete. The two leaves of concrete were designed to be held together by means of stainless steel wall-ties. The internal walls were also loadbearing and were 6 in. thick.

When the height of a block of dwellings was less than 12 storeys, it was possible to use brickwork panels for the front and back walling panels at the outside, and to use loadbearing concrete leaves, 4 in. in thickness, as the continuous leaf on the inside. Alternatively, it was possible to use the normal concrete facing panels together with the loadbearing 4 in.-thick concrete leaf on the inside.

If the building was in excess of 12 storeys in height, it was necessary to provide the full 6 in.-thick loadbearing structural concrete leaves as the inside layer. The concrete facing leaves projected beyond the internal structural walling units so that when the structural units were about 5 in. apart, the 3 in.-thick facing concrete leaves were 0.5 in. apart. This gap was made weathertight by means of a neoprene or plastic strip which springs into two facing grooves of adjoining facing slabs. A strip of expanded polystyrene 6 in. x 0.75 in. was introduced on the inside of this joint so as to make a continuous insulation layer with the remaining expanded polystyrene. The space between the two walling units and the internal walling unit was filled with in-situ concrete.

Once a complete lift of walls had been placed, the flooring units were erected. The flooring units were generally 6 in. in thickness and had transverse ducts of oval cross-section. The flooring slabs were lifted up by means of steel reinforcement loops emerging from the top surfaces, which are then knocked back and were either hidden in the floor screed or covered over by the timber floor used. The bottom of the flooring slab was completely smooth so that it may serve as ceiling for the flat underneath. Two different types of flooring surfaces were used above:

1. Supported wood flooring:

This type of floor construction was used when Gas or other types of central heating system were used; and

2. Concrete flooring with underfloor heating:

The 2.5 in.-thick flooring screed which contains the electric heating coils was spread above the flooring slab. Some complete flooring slabs with electric underfloor heating incorporated in the flooring screed were also produced at the factory. The surface was covered by thermo plastic tiles [27].

The space between the structural flooring slab and the expanded polystyrene slab on the inside of the facing wall slab was filled with in-situ concrete, to the same level as the final floor surface. Steel rods penetrate through this in-situ concrete and protrude about 3 in. at the top. The next course of walling slab were lifted into position by a tower crane and were placed on to a layer of drypack concrete, 1.25 in.-thick, so that the holes on the underside of the new lift of walls engaged the rods emerging from the head of the wall beneath. The gap between the top and bottom leaves of outer leaves of sandwich panels was again 0.5 in and this horizontal gap was closed by using plastic or neoprene strips which were threaded into grooves in the facing concrete.

The process was repeated. The roof was similar to a floor except that a layer of expanded polystyrene was incorporated, followed by several layers of water-repellent roofing material. The windows used with the Bison WF system were cast into the walls in the factory. Usually the windows were painted and glazed at the site. Floor to floor heights were either 8 ft 4 in. or 8 ft. 9 in. which gives floor to ceiling heights of 7 ft. 6 in. or 8 ft.. Prefabricated refuse chutes were situated in the lobbies.

No scaffolding was required except where a brickwork outer leaf was employed. Plumbing was carried along in the ducts cast into flooring and walling slabs. The electrical system had been designed for the British standards of 200-250V supply. The most common forms of heating used with the Bison WF system were either Electric Underfloor Heating system or Gas Central Heating using gas warm air installation or hot air convection.

A complete range of external finishes was availabe for facing concrete including every type of exposed aggregate, tooled concrete, tiling or brick tiles. All wall and ceiling surfaces were left to receive either texured paint or some form of embossed wallpaper, of which the various plastic types seem to be the most useful. The towers cranes used on such projects had a capacity of about 8-10 ton.

Appendix II

PROXIMA Database of the 427 Multi-storey Dwelling Blocks in Birmingham

ASTON UNIVERSITY IN BIRMINGHAM
TOWER BLOCK ANALYSIS(LPS)
File References:
OR.Con = Original Contract Number
SD = S.D. File Reference
CAN = CAN UK File Reference

K.E.
P/C = Post Code
Ht = Number of Storeys
Dw = Number of Dwellings

LPSORT

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BLOCK NAME	ROAD NAME	P/C	Ht	Dw.	CONST.TYPE	CON. YEAR	START DATE	BUILDG. REGS.	File Reference OR.Con	SD	CAN	REMARKS
ALBERT SHAW HO.	LONGCROFT CLOSE	B35	15	60	WF 281	1969	15SEP66	19JUN67	1524	1292	309	BISON
ALNWICK HOUSE	JARVIS ROAD	B23	11	42	WF TR	1965	13DEC64	27MAY64	861	1347	190	BISON
ARLINGTON HOUSE	SUMMER ROAD	B15	13	52	WF 280	1970	08JUN69	19JUN69	1677	1349	259	BISON
ARUNDEL HOUSE	JARVIS ROAD	B23	11	42	WF TR	1965	13DEC64	27MAY64	861	1347	271	BISON
BALDWIN HOUSE	MILTON STREET	B19	15	58	WF NS	1968	06MAR67	26OCT66	1117	1287	211	BISON
BARBERRY HOUSE	SHANNON ROAD	B38	11	42	WF TR	1965	13DEC65	11DEC64	898	1207	275	BISON
BARN HOUSE	COTTMEADOW DRIVE	B6	13	50	WF DH	1967	13JUN66	21JUN66	921	1346	329	BISON
BARRATTS HOUSE	KIMPTON CLOSE	B14	13	50	WF DH	1967	21FEB66	09MAR66	943	1258	324	BISON
BARROW HOUSE	MEYRICK WALK	B16	9	36	WF 240	1971	10MAY70	27APR71	1890	1296	351	BISON
BARRY JACKSON T.	CLIFTON ROAD	B6	20	118	WF 340	1972	04JAN70	14APR72	1892	1397	129	BISON
BELLFIELD HOUSE	THORNHAM WAY	B14	13	50	WF DH	1966	25APR65	20MAY65	909	1263	325	BISON
BERKELEY HOUSE	JARVIS ROAD	B23	11	42	WF TR	1965	13DEC64	27MAY64	861	1347	272	BISON
BOWER HOUSE	PANNEL CROFT	B19	13	50	WF DH	1967	06OCT66	13OCT65	1118	1264	265	BISON
BRIDGEMEADOW HO	FOLKESTONE CROFT	B36	13	50	WF DH	1967	30AUG66	10FEB66	945	1265	163	BISON
BRIDPORT HOUSE	HILLWOOD ROAD	B31	11	42	WF TR	1965	07SEP64	11SEP64	865	1372	301	BISON
BROOKPIECE HOUSE	MILSTON CLOSE	B14	13	50	WF DH	1966	25APR65	20MAY65	909	1263	326	BISON
BROOKS TOWER	CLIFFORD WALK	B19	20	118	WF 340	1971	12OCT69	03JUL69	1745	1266	19	BISON
BUCKLAND HOUSE	SUMMER ROAD	B15	13	52	WF 280	1969	08JUN69	19JUN69	1677	1348	260	BISON
BURDOCK HOUSE	SHANNON ROAD	B38	11	42	WF TR	1965	13DEC65	11DEC64	898	1207	276	BISON
CALIFORNIA HOUSE	HILLMEAD ROAD	B38	11	42	WF TR	1965	14SEP64	11SEP64	864	1371	300	BISON
CAMPION HOUSE	REDDITCH ROAD	B38	11	42	WF DH	1966	26JUL65	11JUN65	911	1378	76	BISON
CONCORD TOWER	HAWKER DRIVE	B35	20	116	WF VARIENT	1968	27OCT68	11DEC67	1196	1267	50	BISON
CONEY GREEN HO	CENTRAL AVENUE	B31	11	42	WF TR	1965	01NOV64	11SEP64	863	1370	312	BISON
CORNWALL TOWER	HEATON STREET	B18	18	106	WF 340	1970	24AUG69	03JUL69	1732	1095	19	BISON
CRAB TREE HOUSE	GILES CLOSE	B33	13	50	WF NS	1967	20JUN66	04FEB66	922	1380	131	BISON
DORSET TOWER	CAMDEN STREET	B18	18	106	WF 340	1971	24AUG69	03JUL69	1732	1095	305	BISON
DREWS HOUSE	NETHERAVON CLOSE	B14	13	50	WF DH	1966	25APR65	20MAY65	909	1263	329	BISON
ENSIGN HOUSE	DONIBRISTLE CRO	B35	13	50	WF DH	1966	26JUL65	29JUN65	924	1340	254	BISON
ESSINGTON HOUSE	SLADEFIELD ROAD	B8	15	60	WF DX	1969	11AUG68	05SEP68	1492	1391	282	BISON
FALLOWS HOUSE	RUDDINGTON WAY	B19	13	50	WF VARIENT	1967	13DEC65	29DEC65	894	755	42	BISON
FARCLOSE HOUSE	CAMBRIDGE CRESC	B15	13	50	WF DH	1967	15AUG66		946	1349	261	BISON
FLINT TOWER	ICKNIELD PORT RD	B16	20	76	WF 230	1971	08FEB70		1504	1398	298	BISON
GILES CLOSE HO	GILES CLOSE	B33	13	50	WF NS VAR.	1967	20JUN66	04FEB66	922	1380	132	BISON
HARRISON HOUSE	BRITFORD CLOSE	B14	13	50	WF DH	1966	21FEB66	09MAR66	943	1258	337	BISON
HEATH HOUSE	BAVERSTOCK ROAD	B14	12	50	WF DH	1966	21FEB66	09MAR66	943	1258	346	BISON
HEATHER HOUSE	SHANNON ROAD	B38	11	42	WF TR	1965	13DEC65	11DEC64	898	1207	277	BISON
HERMES HOUSE	INNSWORTH DRIVE	B35	13	50	WF DH	1966	26JUL65	29JUN65	924	1340	280	BISON
HERON COURT	EMSCOTE DRIVE	B73	13	50	WF SC	1967		WF SC		1339	47	BISON
HILLCROFT HOUSE	ALCESTER ROAD	B14	13	50	WF DH	1966	21FEB66	09MAR66	943	1258	338	BISON
HODGSON TOWER	GUILDFORD DRIVE	B19	20	118	WF 340	1971	16NOV69	03JUL69	1747	1395	143	BISON
HOLLOW MEADOW HO	BROMFORD DRIVE	B36	13	50	WF DH	1967	30AUG66	10FEB66	945	1265	225	BISON
JAMES HOUSE	NEWTON DRIVE	B19	13	50	WF DH	1967	06OCT66	13OCT65	1118	1264	266	BISON
JORDAN HOUSE	BLOSSOM GROVE	B36	13	50	WF DH	1967	30AUG66	10FEB66	945	1265	237	BISON
KINGSPIECE HOUSE	BLOSSOM SQUARE	B36	13	50	WF DH	1967	30AUG66	10FEB66	945	1265	238	BISON
KINGSWOOD HOUSE	KIMPTON CLOSE	B14	13	50	WF DH	1967	21FEB66	09MAR66	943	1258	347	BISON
LAKEHOUSE COURT	FOSSEWAY DRIVE	B23	13	52	WF SC	1970		WF SC		1339	371	BISON
LAVENER HOUSE	SHANNON ROAD	B38	11	42	WF TR	1966	13DEC65	11DEC64	898	1207	278	BISON
LEA HOUSE	WOODVIEW DRIVE	B15	13	50	WF DH	1967	15AUG66		946	1349	262	BISON
LLOYD HOUSE	NEWTON DRIVE	B19	13	50	WF DH	1967	06OCT66	13OCT65	1118	1264	267	BISON
METEOR HOUSE	FILTON CROFT	B35	13	50	WF DH BRYANT	1966	26JUL65	29JUN65			255	BISON
MIDDLEFIELD HO	BRITFORD CLOSE	B14	13	50	WF DH BRYANT	1966	21FEB66	09MAR66	943	1259	[illegible]	BISON
MILL HOUSE	COTTSMEADOW DRIV	B8	13	50	WF DH BRYANT	1967	13JUN66	21JUN66	921	1346	[illegible]	BISON

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BLOCK NAME	ROAD NAME	P/C	Ht	Dw.	CONST. TYPE	ACC. YEAR	START DATE	BUILDG. REGS.	File Reference OR.Con	SD	CAN	REMARKS
MOOR HOUSE	DRUIDS LANE	B14	13	50	WF DH BRYANT	1966	25APR65	20MAY65	905	1263	221	BISON
MOUNDSLEY HOUSE	BAVERSTOCK ROAD	B14	13	50	WF DH BRYANT	1967	25FEB66	09MAR66	947	1258	343	BISON
NETLEY HOUSE	SELCROFT AVENUE	B32	11	42	WF BRYANTS	1965	01JUN64	19JUN64	862	1342	291	BISON
NORFOLK HOUSE	PARK ROAD	B19	18	106	WF 340 BRYAN	1971	24AUG69	03JUL69	1772	1095	306	BISON
NORMANSELL TOWER	WATERWORKS ST	B6	18	106	WF 340 BRYAN	1972	29MAR71	25OCT72	2070	1400	125	BISON
OAST HOUSE	GUMBLEBERRYS CL	B8	13	50	WF DH	1967	13JUN66	21JUN66	901	1246	341	BISON
OSCOTT COURT	FOSSEWAY DRIVE	B23	12	52	WF SC	1970			WF SC	1009	061	BISON
PARKER HOUSE	BRITFORD CLOSE	B14	13	50	WF DH	1966	21FEB66	09MAR66	943	1255	340	BISON
PENNYCROFT HOUSE	RATTLECROFT	B33	13	52	WF NE VAR.	1967	20JUN66	04FEB66	922	1380	133	BISON
PITMEADOW HOUSE	POUND ROAD	B14	13	50	WF DH	1966	25APR65	20MAY65	905	1263	227	BISON
PLECK HOUSE	WINTERBOURNE CR	B14	13	50	WF DH	1966	25APR65	20MAY65	905	1263	222	BISON
PRINCETHORPE TOW	CONYBERE STREET	B12	20	80	WF 250	1970	27JUL69	11SEP69	1745	1294	299	BISON
SADLER HOUSE	NEWTOWN DRIVE	B19	13	50	WF DH	1967	06OCT66	13OCT65	1118	1264	268	BISON
SAFFRON HOUSE	REDDITCH ROAD	B38	11	50	WF DH	1966	27JUL65	11JUN65	911	1378	90	BISON
SALISBURY TOWER	MIDDLEWAY VIEW	B19	20	116	WF VARIENT	1968	26JUN67	22AUG67	1213	1287	40	BISON
SAPPHIRE TOWER	PARK LANE	B6	20	118	WF 340	1971	04JAN70	05AUG71	1892	1397	025	BISON
SAXELBY HOUSE	KIMPTON CLOSE	B14	13	50	WF DH	1967	21FEB66	09MAR66	943	1253	326	BISON
SAYER HOUSE	PANNEL CROFT	B19	13	50	WF DH	1967	06OCT66	13OCT65	1118	1264	269	BISON
SORREL HOUSE	TYBURN ROAD	B24	9	34	WF TR	1964	16SEP63	16AUG63	817	1366	145	BISON
SPEEDWELL	HILLMEADS ROAD	B38	11	42	WF VARIENT	1967	13DEC65	12JAN66	913	1299	206	BISON
ST.ALBANS HOUSE	SELCROFT AVENUE'	B32	11	42	WF	1965		19JUN64	862	1342	292	BISON
STOKESAY HOUSE	JARVIS ROAD	B23	11	42	WF TR	1965	13DEC64	27MAY64	861	1347	273	BISON
STONELEIGH	SELCROFT AVENUE	B32	11	42	WF	1965	01JUN64	19JUN64	862	1342	290	BISON
THIRLMERE HOUSE	ROMAN WAY	B15	11	42	WF	1967	10JUN66	22APR66	940	1360	294	BISON
THISTLE HOUSE	BROMFORD DRIVE	B36	13	50	WF DH	1967	30AUG66	10FEB66	945	1265	340	BISON
THORNTON HOUSE	RUDDINGTON WAY	B19	13	50	WF VARIENT	1967	13DEC65	29DEC65	884	755	44	BISON
TINTERN HOUSE	SELCROFT AVENUE	B32	11	42	WF	1964	01JUN64	19JUN64	862	1342	295	BISON
TOPFIELD HOUSE	DRUIDS LANE	B14	13	50	WF DH	1966	25APR65	20MAY65	905	1263	323	BISON
VALIANT HOUSE	HEYFORD WAY	B35	13	50	WF DH	1966	28DEC65	18OCT65	925	1381	281	BISON
VAUGHTON HOUSE	WOODVIEW DROVE	B15	13	50	WF DH	1967	15SEP66		946	1349	263	BISON
WESTON HOUSE	RUDDINGTON WAY	B19	13	50	WF VARIENT	1967	13DEC65	29DEC65	884	755	43	BISON
WHEELDON HOUSE	LONGLEY CRESCENT	B26	11	43	WF 250	1971	05APR71	08JUL71	2121	1281	192	BISON
WHITE HOUSE	PANNEL CROFT	B19	13	50	WF DH	1967	06OCT66	13OCT65	1118	1264	270	BISON
WIGGIN TOWER	CLIFFORD WALK	B19	20	118	WF 340	1971	12OCT69	03JUL69	1748	1266	170	BISON
WINDERMERE HOUSE	VINCENT DRIVE	B15	11	42	WF	1967	10JUN66	22APR66	940	1360	296	BISON
WINDSOR HOUSE	JARVIS ROAD	B23	11	42	WF TR	1965	13DEC64	27MAY64	861	1347	274	BISON
WOBURN HOUSE	WOODVIEW DRIVE	B15	13	52	WF 280	1970	08JUN69	19JUN69	1677	1348	264	BISON
WYRLEY HOUSE	SCAFFEL DRIVE	B23	13	50	WF DH	1967	03OCT66	24JUN66	933	1282	212	BISON
BARFORD HOUSE	GOOCH STREET	B5	13	50	FRAM LP	1969	02JUN68	29JAN68	1356	1289	112	FRAM
BARTLEY HOUSE	PENRITH CROFT	B33	13	50	FRAM LP	1968	13JUN66	09MAY66	922	1290	241	FRAM
BROADMEADOW HO	PENRITH CROFT	B33	13	50	FRAM LP	1968	13JAN66	09MAY66	922	1290	240	FRAM
DUNCHURCH HOUSE	SHERLOCK STREET	B5	13	50	FRAM LP	1969	02JUN68	29JAN68	1356	1289	95	FRAM
DURHAM HOUSE	ACORN GROVE	B1	20	80	FRAM LP	1970	08DEC68	21NOV66	1627	1291	197	FRAM
EARLSWOOD HOUSE	BARROW WALK	B5	13	50	FRAM LP	1970	04AUG68	22MAY68	1269	1292	96	FRAM
LAPPATH HOUSE	DELLA DRIVE	B32	13	50	FRAM LP	1968	13JUN66	09MAY66	922	1290	226	FRAM
LAPWORTH HOUSE	BARROW WALK	B5	13	50	FRAM LP	1969	26NOV67	04AUG67	1269	1289	99	FRAM
NEAR OAK HOUSE	DELLA DRIVE	B32	13	50	FRAM LP	1968	13JUN66	09MAY66	922	1290	247	FRAM
SOUTERS HOUSE	GRAZEBROOK CROFT	B33	13	50	FRAM LP	1968	13JUN66	09MAY66	922	1290	248	FRAM

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BLOCK NAME	ROAD NAME	P/C	Ht	Dw.	CONST.TYPE	ACQ. YEAR	START DATE	BUILDG. REGS.	File Reference OR.Con	SD	CAN	REMARKS
ABBINGDON TOWER	YATESBURY AVENUE	B35	16	92	16/F/63	1967	24JAN65	17MAR65	893	1026	6	
ADELAIDE TOWER	PACKINGTON AVE	B34	9	36	AFC-BISON	1962	20APR60	11MAY60	AFC3	1.80	89	
AINSWORTH HOUSE	WYCHALL ROAD	B31	8	45	WATES	1957	12APR56	310CT55	493	1025	350	
ALBANY HOUSE	SHOPTON RD	B34	13	50	BLG DEP	1967	110CT64	14FEB64	815	1026	74	
ALLENSMOOR HOUSE	LADYCROFT	B16	6	36		1959	20FEB57	06JUN57			333	
ANDOVER HOUSE	RYE GRASS WALK	B35	11	42	11/F/64	1967	21MAR65	11NOV65	899	1076	9	
APPLETON HOUSE	LEY HILL FARM	B31	8	40	NO FINES Y	1956	16JAN55	01JUN54	476	1106	34	
ARGOSY HOUSE	FARNBOROUGH ROAD	B35	11	42	11/F/63	1966	14MAY64	09NOV64	860	1019	364	
ARLEY HOUSE	SHELDON HEATH RD	B26	9	34	BLYTHE	1968	10JUL67	03MAY66	517/797	1309	161	
ASCOT COURT	ABDON AVENUE	B29	9	36		1975			SVT	1331	360	
ASHFIELD HOUSE	BROMPTON POOL RD	B28	8	32	AFC-BISON	1960	29DEC58	230CT58	612	1024	124	
ASHFORD TOWER	SALOP STREET	B12	9	36	AFC-FRAM	1962	14JUN59	24JUN60	AFC2	1015	111	
ASHTREE HOUSE	BRYMER PLACE	B7	6	36	TREE	1959	17AUG59	05JUL60	621/680	1145	315	
AUCKLAND HOUSE	WELSH FARM ROAD	B10	9	36	WATES C & B	1964	07AUG62	02JUL63	790	1037	229	
AUDLEIGH HOUSE	BELL BARN ROAD	B15	9	36	AFC-INSITU	1967	22AUG66	15SEP66	AFC1	1322	118	
AUSTER HOUSE	FARNBOROUGH ROAD	B35	11	42	11/F/64	1966	16JAN65	20NOV65	894	1019	162	
AVERY HOUSE	SHIFTON ROAD	B16	9	34	RB/9/60	1960	12MAR61	07JUN61	741/807	1024	101	
AVON HOUSE	GT COLMORE ST	B15	6	30	NO FINES Y	1954	17NOV52	22JAN53	219	1050	176	
AVRO HOUSE	FARNBOROUGH ROAD	B35	11	42	11/F/63	1965	14MAY64	09NOV64	860	1019	164	
AYLESBURY HOUSE	TURVES GREEN	B31	6	24	DEELEY	1957	19MAR53		272	1008	149	
BAKEMAN HOUSE	THE TIVOLI	B26	10	120	TOKEN	1968	01SEP65	060CT66	868	1070	221	
BALFOUR HOUSE	CAWDOR CRESCENT	B16	9	52	9/M/62	1965	01FEB64	30AUG63	752	1026	334	
BANBURY HOUSE	SHIRESTONE ROAD	B33	6	30	NO FINES Y	1953	07JAN52		191	1001	170	
BASKERVILLE TOW	KENETONE CROFT	B12	9	36	AFC-FRAM	1961	06APR59	06JUL59	AFC2	1015	113	
BAYLEY TOWER	CHIPPERFIELD RD	B36	20	116	NO FINES	1967	29MAR68	25JUN66	944	1309	200	
BEALE HOUSE	CAWDOR CRESCENT	B16	9	52	9/M/62	1965	01FEB64	30AUG63	752	1026	331	
BEAUMARIS HOUSE	MERRITS HILL	B31	9	34	BUILDINS DEP	1966	29JUN64	14JUN64	810	1241	153	
BEECH HILL HOUSE	FIELD LANE	B32	9	36	C & B INFILL	1965	04DEC62	14SEP62	789	1219	201	
BEWDLEY HOUSE	SHELDON HEATH RD	B26	9	34	C & B INFILL	1965	10JUN63	03AUG62	517/797	1308	289	
BIRCHFIELD TOW	BIRCHFIELD ROAD	B19	16	90	HB/58/16	1962	11JAN60	30SEP60	684	1307	185	
BLAKEMERE HOUSE	GRASTON CLOSE	B16	6	25	MORRIS JACOM	1960	20FEB57	06JUN57				
BLYTHE HOUSE	BOTANY WALK	B16	9	34	BUILDING DEP	1965	09APR64	28DEC61	517/797	1059	332	
BOULTON POINT	ASTON HALL RD	B6	12	36	WHITTALL	1957	02MAR53	18SEP52	230	1205	342	
BOUNDARY HOUSE	HOLLIES CROFT	B5	13	50	WATES	1968	17APR67	17AUG65	1165	915	19	
BOVINGDON TOWER	YATESBURY AVENUE	B35	16	92	16/F/63	1967	24JAN65	17MAR65	893	1026	4/1	
BOWATER HOUSE	ALDGATE GROVE	B19	11	40	RB/11/62	1965	02MAR64	02APR64	826	1100	250	
BRADBEER HOUSE	FRANCIS ROAD	B16	9	34	RB/9/60	1964	24JUL62	07JUL62	741/807	1024	-NE	
BRADFIELD HOUSE	GREENVALE AVE	B26	6	40	NO FINES Y	1954	22JUN53	04JUN53	222	1022	165	
BRADWELL HOUSE	LEY HILL FARM	B31	8	40	NO FINES Y	1957	16JAN55	01JUN54	476	1106	36	
BRAMBER HOUSE	STOKESAY GROVE	B31	8	32	AFC-WATES	1958	20MAY57		575	546	354	
BRANDWOOD HOUSE	GROVE ROAD	B14	9	34	C & B INFILL	1964	28JUN63	25JUL61	791	1194	103	
BRANSFORD TOWER	VAUGHTON STREET	B12	9	34	AFC-WIMPEY	1960	12JAN59	26JUN59	AFC3	1096	52	
BRECON TOWER	GUILD CLOSE	B16	16	93	TERSON	1965	25NOV63	01NOV63	764/923	1016	102	
BRIDGENORTH HO	MEADWAY	B33	7	36	MFS36	1958	05AUG56	29AUG57	527	1010	202	
BRINKLOW TOWER	HIGHGATE STREET	B12	20	116	NO FINES T	1967	040CT65	10SEP65	917/1191	1040	051	
BRISBANE HOUSE	KITSLAND ROAD	B34	7	35	SSC	1958	15APR55	04MAR54	259	1072	193	
BROADHEATH HOUSE	OVERPOOL ROAD	B8	6	30	NO FINES Y	1955	24MAY54	20JAN54	335	1023	102	
BROADWAY HOUSE	STAPLE LODGE RD	B31	6	35	WATES C. C.	1956	26AUG54	03MAY54	462	1305	316	
BROOK TOWER	WODDINGTON ROAD	B75	9	52	LIFT SLAB	1966			531	1250	62	
BROWNING TOWER	OVERBURY ROAD	B31	12	69	WHITTALL	1963	18JUL60	19FEB60	697	1330	166	
BRUNSWICK HOUSE	SHOPTON RD	B34	13	50	BUILDING DEF	1966	110CT64	14FEB64	815	1026	75	
BUCKINGHAM HOUSE	TURVES GREEN	B31	6	24	DEELEY	1956	19MAR53		272	1008	250	

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BURCOMBE TOWER	OLD BELL ROAD	B23	12	67	HB/58/12	1967	09APR58	02JUL58	610	929	31	
CADBURY HOUSE	GREAT HAMPTON RD	B19	11	40	RB/11/62	1965	02MAR64	02APR64	836	1100	284	
CALDER TOWER	BIRCHFIELD ROAD	B19	16	90	HB/58/16	1963	11JAN60	30SEP60	684	1307	186	
CAMBRIDGE TOWER	BRINDLEY DRIVE	B1	16	62	16/F/66	1968	13MAR67	08MAY67	11141531	1386	19	
CAMROSE TOWER	LONG ACRRE	B7	9	33	MORRIS JACOM	1960	09MAR59	02MAY59	648	1309	256	
CANBERRA HOUSE	KITSLAND ROAD	B34	7	35	SSC	1958	25APR55	04MAR54	259	1072	194	
CANTERBURY TOWER	ST MARKS STREET	B16	20	116	NO FINES	1967	24JAN66	26JAN66	882	1374	313	
CANTLOW HOUSE	KETLEY CROFT	B12	9	36	AFC-BISON	1963	27NOV61	29AUG61	AFC2	1215	114	
CAREBROOKE HOUSE	ASTON HALL ROAD	B6	6	24	WHITTALL	1957	27MAR54	04NOV53	284	1358	343	
CARISBROOKE HO	CULMINGTON ROAD	B31	8	32	AFC-WATES CC	1958	20MAY57		575	548	355	
CASTLE HOUSE	MEADWAY	B33	7	42	NO FINES T	1958	05AUG56	29AUG57	527	1210	203	
CAVELL HOUSE	ST.VINCENT ST	B16	8	28	NO FINES	1959	11SEP57	01JAN59	557	1335	234	
CAVENDISH TOWER	WALKERS HEATH RD	B38	14	83	SPECIAL	1961	09SEP59	10SEP59	632	1361	156	
CEDAR HOUSE	DRYLEA GROVE	B36	8	32	FPC/55	1957	26JUN56		551/562	1334	220	
CENTURY TOWER	DOLLERY DRIVE	B5	20	116	WATES 20/F/6	1968	26OCT66	13NOV66	128	916	19	
CHADWICK HOUSE	OVERPOOL ROAD	B8	6	30	NO FINES Y	1955	24MAY54	20JAN54	335	1223	123	
CHAMBERLAIN HO	SKIPTON ROAD	B16	9	34	RB/9/60	1963	13MAR61	07JUN61	741/807	1024	-NR	
CHARLBURY TOWER	SOUTHGATE AVEN	B5	9	36	AFC-FRAM	1961	26JAN59	21AUG59	AFC3	1296	115	
CHARLECOTE TOWER	DORKING GROVE	B15	20	116	20/F/66	1965	04MAY64	14SEP64	802/882	1364	79	
CHATSWORTH TOWER	BELL BARN ROAD	B15	20	116	20/F/66	1966	25MAY64	14SEP64	802/882	1402	146	
CHESTNUT HOUSE	NEWHAVEN CLOSE	B7	12	68	WATES C & B	1964	06JUL69	07OCT68	758	1333	302	
CHILLINGHOME TOW	HYPERION ROAD	B36	20	116	NO FINES	1967	28MAR68	25JUN66	944	1209	235	
CHISWICK HOUSE	BELL BARN ROAD	B15	9	36	AFC-FRAM	1967	10JAN66	26JAN66	AFC1	1022	119	
CHIVENOR HOUSE	DREM CROFT	B35	11	42	11/F/64	1966	08FEB65	26JUL65	890	1375	9	
CHURCHFIELD HO	DUDDESTON MANOR	B7	12	68	WATES CROSSW	1965	16DEC63	23DEC63	826	1368	77	
CLAVERDON HOUSE	HOLLYBANK ROAD	B14	6	30	NO FINES Y	1955	01JAN54	18MAR54	299	1016		
CLAYTON HOUSE	CAWDOR CRESCENT	B16	9	52	9/M/63	1965	01FEB64	30AUG63	752	1326	335	
CLEEVE HOUSE	BROMFORD LANE	B34	8	32	FPC 55	1959	07JAN58	22AUG59	564	1360	148	
CLEVELAND TOWER	HOLLOWAY HEAD	B1	32	244	INSITU	1970	11AUG68	25APR68	1111	1385	17	
CLOVELLY HOUSE	LOWER BEECHES RD	B31	9	36	AFC-WATES	1962	27SEP66	15AUG66	584/717	1014	67	
CLYDE TOWER	BIRCHFIELD ROAD	B19	20	116	NO FINES	1967	27JUN65	02JUL65	901	1212	38	
CLYDESDALE TOWER	HOLLOWAY HEAD	B1	32	244	INSITU	1971	11AUG68	25APR68	1111	1385	18	
COCKSMOOR HOUSE	GROVE ROAD	B14	9	33	C & B INFILL	1964	28JAN63	25JUL61	791	1194	110	
COLLETTE HOUSE	EVERITT CLOSE	B16	8	44	NO FINES	1958	11SEP57	01JAN59	557	1335	233	
COLLINGS HOUSE	HUNTLY ROAD	B16	9	34	RB/9/60	1963	13MAR61	07JUN61	741/807	1024	103	
COMET HOUSE	FARNBOROUGH ROAD	B35	11	42	11/F/63	1965	14MAY64	09NOV64	860	1019	197	
COMPTON HOUSE	MEADWAY	B33	8	48	NO FINES T	1958	05AUG56	29AUG57	527	1210	379	
CONISTON HOUSE	BANTOCK WAY	B17	11	40	RB/11/62	1965	01JUN64	26MAY64	777	1218	68	
CONWAY HOUSE	MERRITS HILL	B31	9	34	BUILDING DEP	1966	29JUN64	14JUN64	810	1341	154	
COPESHILL COURT	MOUNT VIEW	B75	9	51	SC L	1967			SC L	1357	366	
COPPICE HOUSE	PEMBERLEY ROAD	B27	12	70	M&J SPEC	1964	27MAR61	19JUN61	726	915	140	
COSFORD TOWER	YATESBURY AVENUE	B35	16	92	16/F/63	1966	24JAN65	17MAR65	893	1226	5/1	
COTSWOLD HOUSE	WHITLOCK GROVE	B14	8	32	FPC55/R	1957	26MAR56	20AUG57	536	1211	55	
COURTWAY HOUSE	BUSHWOOD ROAD	B29	8	34	AFC-BISON	1960	14SEP59	22OCT58	AFC4	1323	149	
CRANLEIGH HOUSE	BALDMOOR LAKE RD	B23	9	34	STUBBING	1965	06JAN64	15OCT63	804A	1310	307	
CRANWELL TOWER	YATESBURY AVENUE	B35	16	92	16/F/63	1966	24JAN65	17MAR65	893	1226	5/1	
CRESCENT TOWER	BRINDLEY DRIVE	B1	16	62	16/F/66	1968	13MAR67	08MAY67	11141531	1386	19	
CULWORTH HOUSE	STAPLE LODGE RD	B31	6	35	WATES C. C.	1956	26AUG54	03MAY54	462	1305	317	
DANESMOOR HOUSE	HOB MOOR ROAD	B25	6	24	COL/L/B	1957	29SEP57	13FEB53	291	1074	31	
DAVID COX TOWER	LONG NUKE ROAD	B31	9	36	AFC-LIFT	1961	14SEP59	24AUG59		1317	204	
DERWENT HOUSE	BANTOCK WAY	B17	11	40	RB/11/62	1965	01JUN64	26MAY64	777	1218	69	
DESBOROUGH HOUSE	DICKENS GROVE	B14	8	32	FPC55/R	1958	26MAR56	20AUG57	536	1211	55	

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DEVON HOUSE	LOWER BEECHES RD	B31	9	36	AFC-WATES	1962	27SEP60	15AUG60	584/717	1014	64	
DIXON HOUSE	HUNTLY ROAD	B16	9	34	RB/9/60	1963	13MAR61	07JUN61	741/807	1024	-NS	
DONINGTON HOUSE	MEADWAY	B33	8	48	NO FINES T	1958	05AUG56	29AUG57	527	1010	379	
DOUGLAS HOUSE	BERRANDALE ROAD	B36	8	32	FFC55	1958	21AUG57		551/562	1034	226	
DOVEDALE HOUSE	TAMERTON ROAD	B32	6	35	WATES C. C.	1956	21MAR55	04APR55	491	1006	244	
DOVERCOURT HOUSE	BELL BARN ROAD	B15	6	32	F/6A	1961	12MAY58	11OCT57	593/667	1028	362	
DOVEY TOWER	DUDDESTON MANOR	B7	16	92	16/F/63	1967	17JAN65	03FEB65	825	917	19	
DOWRY HOUSE	RUBERY LANE	B45	8	40	NO FINES Y	1957	21NOV55		474	777		
DUNEDIN HOUSE	WELSH HOUSE FARM	B32	9	36	C & B INFILL	1964	07AUG62	03JUL63	793	1007	232	
EDMONTON HOUSE	BENMORE AVENUE	B5	11	40	RB/11/62	1965	19AUG63	29NOV63	755	1029	106	
ELIZABETH FRY HO	EVERITT CLOSE	B16	8	28	NO FINES	1957	11SEP57	01JAN59	557	1035	222	
ELMBRIDGE HOUSE	CHADDESLEY ROAD	B31	6	27	WATES	1957	12APR56	31OCT55	490	1025	374	
ELMSTEAD TOWER	BERRINGTON WALK	B5	9	36	AFC-TRAD	1960	29DEC55	25NOV58	AFC3	1096	97	
ELMTREE TOWER	BRADBURNE WAY	B7	12	71	SPECIAL	1961	14SEP59	15SEP59	679	1303	150	
ELSWORTH HOUSE	CHADDESLEY ROAD	B31	8	48	WATES C. C.	1957	12APR56	31OCT55	490	1325	381	
EPSOM COURT	ABDON AVENUE	B29	9	36		1975			BVT	1001	370	
EVESHAM HOUSE	WINDSOR STREET	B7	6	29	CROSSWALL	1957	18APR56	09APR56				
EXETER HOUSE	LOWER BEECHES RD	B31	9	36	AFC-WATES	1962	27SEP60	15AUG60	584/717	1014	65	
FAIRBOURNE TOWER	PORTFIELD GROVE	B23	11	67	HB/58/12	1960	09APR60	02JUL58	610	929	01	
FAIRFAX COURT	STEPHENS ROAD	B76	9	52	LIFT SLAB	1966			SC1	1034	367	
FARADAY HOUSE	BELL BARN ROAD	B15	9	36	AFC-BISON	1963	21AUG61	05OCT61	AFC1	1322	120	
FERNDALE HOUSE	TAMERTON ROAD	B32	6	35	WATES C. C.	1956	21MAR55	04APR55	491	1006	245	
FIRS HOUSE	DRYLEAS AVENUE	B36	8	32	FFC55	1957	25JUN56		551/562	1334	223	
FREMANTLE HOUSE	KITSLAND ROAD	B34	7	35	SSC	1958	25APR55	04MAR54	259	1072	205	
FROGMOOR HOUSE	HOB MOOR ROAD	B25	6	24	COL/L/3	1957	29SEP57	13FEB53	291	1074	31	
GALTON TOWER	CIVIC CLOSE	B1	16	58	16/F/65	1969	25AUG68	16MAY68	1114155	1393	-19	
GEACH TOWER	UXBRIDGE STREET	B19	16	90	HB/58/16	1966	06APR64	12JUL64	559/834	1010	91	
GLENDALE TOWER	BEECHMOUNT DRIVE	B23	12	67	HB/58/12	1959	09APR60	02JUL58	610	929	01	
GOSMOOR HOUSE	YEW TREE LANE	B26	6	24	COL/L/B	1957	29SEP57	13FEB53	291	1074	31	
GOWER HOUSE	LOCKINGTON CROFT	B32	9	36	AFC-FRAM	1967	02MAY65	25JUN65	AFC4	1020	257	
GREENBANK HOUSE	DENBY CLOSE	B7	7	51	LAINGS	1960	02JUL58	30SEP58	602	1042	377	
GREENFIELD HOUSE	GREENVALE AVE	B26	6	30	NO FINES Y	1954	22JUN53	04JUN53	222	1022	169	
GREENFORD HOUSE	FAULKNERS FARM	B33	8	48	NO FINES	1957	14MAY56	12OCT55	530	1036	216	
GRESHAM TOWER	SHAWBURY GROVE	B12	9	36	AFC-FRAM	1961	28APR59	20AUG59	AFC2	1213	115	
HADDON TOWER	BRISTOL STREET	B5	20	116	20/F/63	1967	28FEB65	18NOV65	802/882	1404	36	
HALIFAX HOUSE	BRISTOL ROAD	B5	11	40	RB/11/62	1966	19AUG63	29NOV63	755	1029	78	
HALLOW HOUSE	CHADDESLEY ROAD	B31	6	27	WATES C. C.	1957	12APR56	31OCT55	490	1025	357	
HAMILTON HOUSE	MURREL CLOSE	B5	11	40	RB/11/62	1966	19AUG63	29NOV63	755	1029	79	
HAMPDEN HOUSE	FARNBOROUGH ROAD	B35	11	42	11/F/64	1966	10JAN65	20NOV65	894	1019	279	
HARLECH TOWER	WILMOT DRIVE	B23	16	91	HB/58/16	1960	09APR58	02JUL58	610	929	01	
HAWKER HOUSE	FARNBOROUGH ROAD	B35	11	41	11/F/64	1966	10JAN65	20NOV65	894	1019	206	
HERCULES HOUSE	RAWLINGS CROFT	B35	11	42	11/F/64	1967	10JUN66	20JUN65	920		150	
HEREFORD HOUSE	KNOLL CROFT	B16	5	25	MAC	1958	20FEB57	06JUN57			336	
HERTFORD HOUSE	STAINSBY AVE	B19	12	68	C & B INFILL	1962	15MAY61	01JUN61	703	1004	48	
HIGH TOWER	DUDDESTON MANOR	B7	12	66	STEEL FRAME	1955	16APR52		58	1098	51	
HIGHGATE HOUSE	SOUTHACRE AVE	B5	9	36	AFC-BISON	1963	15MAY61	12DEC61	AFC3	1096	95	
HILLSIDE HOUSE	COCK HILL LANE	B45	8	40	NO FINES Y	1957	21NOV55		474	777	82	
HOBBIS HOUSE	REDDITCH ROAD	B38	11	42	STRESS LINE	1968		18AUG66	925	1082	259	
HOGARTH HOUSE	BELL BARN ROAD	B15	9	36	AFC-BISON	1962	21AUG61	05OCT61	AFC1	1322	121	
HOLBROOK TOWER	BROMFORD DRIVE	B34	20	116	NO FINES	1968	28MAR68	25JUN66	944	1209	203	
HOLLAND HOUSE	GREAT HAMPTON RD	B19	11	40	RB/11/62	1965	02MAR64	02APR64	806	1100	285	
HOLLYFIELD HOUSE	PEMBERLEY ROAD	B[illegible]	1[illegible]	76	MAC SPEC	1963	27MAR61	1[illegible]JUN62	7[illegible]	715	1[illegible]	

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HOME MEADOW HO	PEMBERLEY ROAD	B27	12	70	M&J SPEC	1964	27MAR61	19JUN62	728	915	180	
HOME TOWER	DUDDESTON MANOR	B7	12	66	STEEL FRAME	1954	16APR51		85	1098	A2	
HUMBER TOWER	FRANCIS STREET	B7	16	92	16/F/63	1966	17JAN65	03FEB65	825	917	19	
HUNTINGTON HOUSE	FAULKNERS FARM	B33	8	48	NO FINES	1959	14MAY56	12OCT56	530	1336	217	
INGLETON HOUSE	BELL BARN ROAD	B15	6	35	F/6A	1960	12MAY58	11OCT57	593/667	1329	363	
INKERMAN HOUSE	NEWTOWN SHOPPING	B19	15	144	INSITU	1968	12SEP65		920	1379	392	
JAMES WATT POINT	ASTON HALL RD	B6	12	36	WHITTALL	1956	02MAR53	19AUG52	230	1208	369	
JAVELIN HOUSE	FARNBOROUGH ROAD	B35	11	42	11/F/64	1967	06JUN65	06OCT66	897	1019	9	
JOHN ASH HOUSE	PAYNTON WALK	B15	6	24	F6A	1962	06JUL59	10FEB60	593/667	1328	160	
JOHN FEENEY TOW	LONG NUKE ROAD	B31	9	36	AFC-LIFT	1961	14SEP59	24AUG59		1317	258	
JUNIPER HOUSE	FIRS FARM DRIVE	B36	8	32	FPC55	1957	25JUN56		551/562	1334	207	
KEMBLE TOWER	YATESBURY AVENUE	B35	16	92	16/F/63	1967	24JAN65	17MAR65	893	1026	1	
KEMPSEY HOUSE	KITWELL LANE	B32	9	34	BRYANTS	1966	21SEP64	14JUN63	818	1367	314	
KENCHESTER HOUSE	SHYLTONS CROFT	B16	6	39	M&J	1959	20FEB57	06JUN57				
KENDAL TOWER	MALINS ROAD	B17	16	91	LAINGS	1965	01APR63	03JUL63	799	1217	311	
KENILWORTH HOUSE	HOLLYBANK ROAD	B14	6	30	NO FINES Y	1955	01JAN54	16MAR54	299	1016		
KENRICK HOUSE	BEAUFORD ROAD	B16	9	34	RB/9/60	1962	13MAR61	07JUN61	741/807	1024	-NR	
KENTMORE TOWER	BEECHMOUNT DRIVE	B23	12	67	HB/58/12	1960	09APR60	02JUL58	610	929	D1	
KENTS HOUSE	MEADWAY	B33	8	48	NO FINES T	1958	05AUG56	29AUG57	527	1210	376	
KESTERTON TOWER	PARKHOUSE DRIVE	B23	16	93	TERSON	1965	01JAN63	02DEC64	785	574	81	
KESTREL HOUSE	FARNBOROUGH ROAD	B35	11	42	11/F/64	1967	06JUN65	06OCT66	897	1019	164	
KINETON HOUSE	HOLLYBANK ROAD	B14	6	30	NO FINES Y	1955	01JAN54	16MAR54	299	1016		
KINGSBRIDGE HO	FAULKNERS FARM	B33	8	48	NO FINES	1957	14MAY56	12OCT55	530	1336	252	
KINGSTONE HOUSE	STAPLE LODGE RD	B31	6	35	WATES C. C.	1956	26AUG54	03MAY54	462	1305	361	
KITWELL HOUSE	TRIPPLETON AV	B32	6	27	WATES C. C.	1957	11APR56	16FEB56	492	1332	213	
LAMPORT HOUSE	WHITLOCK GROVE	B14	8	32	FPC55	1957	26MAR56	20AUG57	536	1011	55	
LANSDOWN HOUSE	ST COLMORE ST	B15	6	30	NO FINES Y	1954	17NOV52	22JAN53	219	1050	191	
LARCH HOUSE	SHAWSDALE ROAD	B36	8	32	FPC55	1958	25JUN56		551/562	1334	224	
LEBANON HOUSE	BERRANDALE ROAD	B36	8	32	FPC55	1958	21AUG57		551/562	1334	221	
LEDBURY HOUSE	SHIRESTONE ROAD	B33	6	30	NO FINES Y	1953	07JAN52		191	1221	171	
LEOMINSTER HOUSE	TILE CROSS ROAD	B33	6	30	NO FINES Y	1954	07JAN52		191	1221	172	
LINCOLN TOWER	GILBY ROAD	B16	12	67	HB/58/12	1960	01DEC58	10JAN59	655	1362	142	
LITTLE HILL HOUS	HAYES GROVE	B24	9	36	C & B INFILL	1964	[illegible]	17APR63	757A	1195	63	
LONGDALE HOUSE	BICKINGTON	B33	6	35	WATES C. C.	1956	21MAR55	04APR55	491	1306	246	
LONGLANDS HOUSE	BEACH ROAD	B11	8	32	FPC 55	1959	17APR58	11JUN56	554	0	123	
LONGLEAT TOWER	BEXHILL GROVE	B15	20	116	NO FINES	1968	20OCT67	04AUG67	1014	1088	41	
LONGWATER HOUSE	ICKNIELD STREET	B18	8	32	LAINGS	1960	01DEC58	10NOV59	616	1344	157	
LUDLOW HOUSE	HOLLYBANK ROAD	B14	6	30	NO FINES Y	1955	01JAN54	15MAR54	299	1016		
LYNEHAM TOWER	YATESBURY AVENUE	B35	16	92	16/F/63	1967	24JAN65	17MAR65	893	1026	2	
LINTON HOUSE	FAULKNERS FARM	B33	8	48	NO FINES	1957	14MAY56	12OCT55	530	1336	253	
LYSANDER HOUSE	FARNBOROUGH ROAD	B35	11	42	11/F/63	1966	14MAY64	[illegible]	[illegible]	1019	[illegible]	
MAITLAND HOUSE	[illegible] ROAD	B24	7	35	BSC	1958	25APR55	04MAR54	259	1072	188	
MALVERN HOUSE	GARSDALE TERRACE	B7	6	42	LAINGS	1960	[illegible]	[illegible]	[illegible]	1045	304	
MANDERVILLE HO	WALNUT WAY	B31	11	40	11/F/64	1968	13APR67		1091	1384	[illegible]	
MANTON HOUSE	NEWBURY ROAD	B19	12	50	NO FINES	1968	19SEP66	26AUG65	884A	1279	345	
MARTINEAU TOWER	UXBRIDGE STREET	B19	16	90	HB/58/16	1965	06APR64	21JUL64	659/834	1213	93	
MEDWAY HOUSE	CROMWELL STREET	B7	16	90	HB/58/16	1961	21SEP59	04JUN59	644	1345	137	
MELBOURNE HOUSE	BERROWSIDE ROAD	B34	7	35	BSC	1958	25APR55	04MAR54	259	1072	195	
METCHLEY HOUSE	BANTOCK WAY	B17	11	40	RB/11/62	1966	01JUN64	26MAY64	777	1018	70	
MOAT HOUSE	MUNSLOW GROVE	B31	8	32	AFC-WATES	1958	20MAY57		575	548	356	
MONMOUTH HOUSE	SHIRESTONE ROAD	B33	6	30	NO FINES Y	1953	07JAN52		191	1221	173	
MONTREAL HOUSE	BENMORE AVENUE	B5	11	40	RB/11/62	1965	[illegible]	[illegible]	755	1029	[illegible]	

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MUNTZ HOUSE	SKIPTON ROAD	B16	9	34	RB/9/60	1963	13MAR61	07JUN61	741/807	1024	104	
MURDOCH POINT	ASTON HALL RD	B6	12	36	WHITTALL	1956	02MAR53	18SEP52	230	1206	344	
NASEBY HOUSE	WHITLOCK GROVE	B14	8	32	FPC55	1958	26MAR56	20AUG57	538	1211	55	
NASH HOUSE	WYNN ST	B15	6	30	NO FINES Y	1954	17NOV52	22JAN53	219	1350	177	
NEEDWOOD HOUSE	WOODCOCK LANE	B27	8	32	AFC-BISON	1960	06APR59	17JUN59	B/619	908	138	
NEWLAND HOUSE	MELLING WAY	B7	6	42	LAINGS	1960	18AUG58	13JUN59	621/680	1045	237	
NIGHTINGALE HO	GILBY ROAD	B16	6	36	NO FINES	1959	11SEP57	01JAN59	557	1335	227	
NORMANTON TOWER	PORTFIELD GROVE	B23	12	67	HB/58/12	1959	09APR60	02JUL58	610	929	01	
NORTHFLEET TOWER	LOWER BEECHES RD	B31	9	36	AFC-WATES	1959	19JAN59	12JUN60	584/717	1014	66	
NORTHHOLT TOWER	YATESBURY AVENUE	B35	16	92	16/F/63	1967	24JAN65	17MAR65	893	1226	7/1	
NORTON TOWER	CIVIC CLOSE	B1	15	58	15/F/66	1969	25AUG68	16MAY68	1114153	1393	19	
OAK TREE HOUSE	HENEAGE STREET	B7	12	66	C & B INFILL	1963	19JUN61	20JUL61	737	1030	126	
OAKHAM HOUSE	MOUNDSLEY GROVE	B14	8	32	FPC55	1958	26MAR56	20AUG57	538	1211	55	
OAKINGTON HOUSE	ROUND MOOR WALK	B35	11	42	11/F/64	1967	21MAR65	11NOV65	899	1376	9	
OFFENHAM HOUSE	KELLET ROAD	B7	6	39	LAING CROSSW	1957	18APR56	09APR56				
OMBERSLEY HOUSE	CHADDESLEY ROAD	B31	6	27	WATES C. C.	1957	12APR56	31OCT55	493	1325	275	
ORCHARD TOWER	LONG NUKE ROAD	B31	9	36	AFC-LIFT	1961	14SEP59	24AUG59		1317	214	
OREGON HOUSE	BERRANDALE ROAD	B36	8	32	FPC55	1959	21AUG57		551/562	1334	196	
OSBORNE TOWER	GLADSTONE STREET	B6	16	92	16/F/64	1966	08NOV65	27MAY65	881A	1403	092	
OTTAWA HOUSE	MURREL CLOSE	B5	16	92	C & B INFILL	1966	16MAR64	15MAY63	755A	1401	105	
OXFORD HOUSE	TURVES GREEN	B31	6	24	DEELEY	1957	19MAR53		272	1338	251	
PACKWOOD HOUSE	GAYWOOD CROFT	B15	12	46	NO FINES	1966	04JUL65	15DEC65	803	1365	49	
PADBURY HOUSE	LEY HILL FARM	B31	8	40	NO FINES Y	1956	16JAN55	01JUN54	476	1106	05	
PARK COURT	BOLDMERE ROAD	B73	6	35		1964			SC4	1195	60	
PEMBRIDGE HOUSE	GLINGFORD ROAD	B31	6	35	WATES C. C.	1956	26AUG54	03MAY54	462	1305	318	
PERRY GREEN HO	ELCOCK GREEN	B42	3	32	C & B INFIL	1959	11AUG58	16DEC58	558	1380	181	
PERSHORE TOWER	LOWER BEECHES RD	B31	9	36	AFC-WATES	1960	21JAN59	12JUN60	584/717	1014	71	
PINE HOUSE	SHAWSDALE ROAD	B36	8	32	FPC55	1958	25JUN56		551/562	1334	215	
PIONEER HOUSE	FARNBOROUGH ROAD	B35	11	41	11/F/64	1967	06JUN65	06OCT66	897	1019	5	
PLOUGHFIELD HO	BELL CROFT	B16	6	28	M&J	1960	20FEB57	06JUN57			365	
PRIESTLY POINT	ASTON HALL RD	B6	12	36	WHITTALL	1956	02MAR53	18SEP52	230	1208	345	
PRIMROSE TOWER	MEDWAY GROVE	B38	16	91	NO FINES	1966	13DEC64	16DEC64	359	1369	358	
PRITCHETT TOWER	ARTHUR STREET	B10	20	115	WIMPEY 340	1971	02AUG70	19DEC71	1971	1399	128	
PURLEY TOWER	HALESCROFT SQ	B31	8	48	WATES C. C.	1958	26NOV56	22NOV54	494	1327	372	
QUARRY HOUSE	COCK HILL LANE	B45	8	38	NO FINES Y	1957	21NOV55		474	777	83	
QUEBEC HOUSE	MURREL CLOSE	B5	11	41	SB/11/62	1967	11APR65	25FEB65	755	1329	107	
QUEENS TOWER	DUDDESTON MANOR	B7	12	66	WHITTALL	1954	16APR51		86	1098		
RADCLIFFE TOWER	SHAWBURY GROVE	B12	9	36	AFC-FRAM	1962	28APR59	30AUG59	AFC2	1215	117	
RADNOR HOUSE	MERRITS HILL	B31	9	34	BUILDING DEP	1966	29JUN64	14JUN64	810	1341	167	
RAYLEIGH HOUSE	WOODCOCK LANE	B27	8	32	AFC-BISON	1961	06APR59	17JUN59	B/619	908	139	
REA TOWER	MOSBOROUGH CRES	B19	16	88	HB/58/16	1962	14SEP60	15OCT61	689 924	1212	151	
REDDITCH HOUSE	SHIRESTONE ROAD	B33	6	30	NO FINES Y	1953	07JAN52		191	1021	174	
REDHILL HOUSE	HALESCROFT SQ	B31	6	27	WATES C. C.	1956	26NOV56	22NOV54	494	1327	282	
REDWAY COURT	MOUNT VIEW	B75	10	51	SCL	1967			SC L	1357	368	
REDWORTH HOUSE	DEELANDS	B45	8	40	NO FINES Y	1957	05MAR56	01JUN54	475	777	85	
RENDAL HOUSE	TINMEADOW CRESC	B45	12	68	C & B INFILL	1963			736	1301	180	
REPTON HOUSE	SALDMOOR LAKE RD	B23	9	34	STUBBINGS	1965	06JAN64	15OCT63	804A	1310	306	
REYNOLDS HOUSE	NEWBURY ROAD	B19	13	50	NO FINES	1967	19SEP66	26AUG65	894A	1279	046	
RISBOROUGH HOUSE	SHIFNAL WAY	B31	11	42	11/F/64	1968	18APR67		1091	1384	82	
RUSHMORE HOUSE	DEELANDS	B45	8	40	NO FINES Y	1957	05MAR56	01JUN54	475	777	84	
RYLAND HOUSE	GREAT HAMPTON ST	B18	11	4[illegible]	SB/11/63	1965	02MAR64	02APR64	306	1100	256	
SANDFORD HOUSE	SLINGFORD ROAD	B31	[illegible]	[illegible]	WATES C. C.	1956	26AUG54	03MAY54	462	1305	[illegible]	

ASTON UNIVERSITY IN BIRMINGHAM
TOWER BLOCK ANALYSIS
File References:
OR.Con = Original Contract Number
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KEY
P/C = Post Code
Ht = Number of Storeys
Dw = Number of Dwellings

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BLOCK NAME	ROAD NAME	P/C	Ht	Dw.	CONST.TYPE	ACQ. YEAR	START DATE	BUILDG. REGS.	File Reference OR.Con	SD	CAN	REMARKS
SANDHILL HOUSE	MERRITTS HILL	B31	6	27	WATES C. C.	1958	26NOV56	22NOV54	494	1327	373	
SANDHURST HOUSE	ICKNIELD STREET	B18	8	32	LAINGS	1960	01DEC58	13NOV58	616	1344	159	
SANDOWN TOWER	WILLETS ROAD	B31	9	36	AFC FRAM	1961	18FEB59	26JUN59	611	707	85	
SAUNDERTON	LEY HILL FARM	B31	8	40	NO FINES Y	1956	16JAN55	01JUN54	476	1106	02	
SCHOFIELD TOWER	UXBRIDGE STREET	B19	16	90	HB/58/16	1965	06APR64	21JUL64	669/834	1213	84	
SEATON TOWER	LOWER BEECHES RD	B31	9	36	AFC-WATES	1960	19JAN59	12JUN60	584/717	1014	73	
SEVERN TOWER	CROMWELL STREET	B7	16	90	HB/58/16	1962	21SEP59	04JUN59	644	1345	218	
SHAKESPEARE	FAIRFAX ROAD	B31	10	37	INSITU LP	1964	01JUN63	31MAY63	806	1008	384	
SHAWBURY TOWER	YATESBURY AVENUE	B35	16	92	16/F/62	1967	24JAN65	17MAR65	893	1226		
SHAWLEY HOUSE	CHADDESLEY ROAD	B31	6	27	WATES C. C.	1957	12APR56	31OCT55	493	1325	359	
SHELLEY TOWER	OVERBURY ROAD	B31	12	69	WHITTALL	1963	18JUL60	19FEB60	697	1330	155	
SOUTH TOWER	DUDDESTON MANOR	B7	12	66	STEEL FRAME	1954	16APR51		86	1098	A34	
SOUTHAM HOUSE	HOLLYBANK ROAD	B14	6	30	NO FINES Y	1955	01JAN54	18MAR54	299	1016		
SOUTHDOWN HOUSE	CARPERRY CLOSE	B7	6	42	LAINGS	1960	18AUG58	30JAN59	621 680	1045	238	
SOUTHWELL HOUSE	TRIFFLETON AV	B32	6	40	WATES C. C.	1957	11APR56	16FEB56	492	1331	330	
SPRUCE HOUSE	BERRANDALE ROAD	B36	8	32	FPC55	1959	21AUG57		551/562	1334	199	
ST.DENNIS HOUSE	MELVILLE ROAD	B16	8	22	C & B INFILL	1959	11MAR57	27MAR56	560			
ST.HELIER	MELVILLE ROAD	B16	8	22	C & B INFILL	1960	11MAR57	27MAR56	560			
ST.LAWRENCE HO	MELVILLE ROAD	B16	8	22	C & B INFILL	1959	11MAR57	27MAR56	560			
ST.MICHAEL HOUSE	MANOR ROAD	B16	8	22	C & B INFILL	1959	11MAR57	27MAR56	560			
STAFFORD HOUSE	TILE CROSS ROAD	B33	6	30	NO FINES Y	1953	07JAN52		191	1221	175	
STANDLAKE HOUSE	LEY HILL FARM	B31	8	40	NO FINES Y	1956	16JAN55	01JUN54	476	1106	02	
STANDLEYS TOWER	STONNEL GROVE	B23	9	36	AFC-FRAM	1962	06JUL59	24OCT60	677	1023	01	
STEPHENSON TOWER	STATION STREET	B5	20	80	BRYANTS	1967	12NOV65	20AUG65	892	916	37	
STONEYCROFT	EROMFORD DRIVE	B34	20	116	NO FINES	1967	28MAR68	25JUN66	944	1009	239	
STRENSAM HOUSE	SIMONS ROAD	B7	6	32	LAINS CROSSW	1958	18APR56	09APR56				
STUDLEY TOWER	CANFORD CLOSE	B12	20	116	NO FINES	1969	01DEC68	24JAN67	917/1191	1342	054	
SUMMERCOURT HO	BUSHWOOD ROAD	B29	8	32	AFC-BISON	1960	14SEP59	22OCT58	AFC4	1323	179	
SYCAMORE HOUSE	RUPERT STREET	B7	12	68	WATES C & B	1964	07JAN63	26NOV62	758	1333	303	
SYDNEY HOUSE	KITSLAND ROAD	B34	7	35	SSD	1958	25APR55	04MAR54	259	1072	189	
SYLVESTER HOUSE	BERRANDALE ROAD	B36	8	32	FPC55	1959	21AUG57		551/562	1334	219	
TAUNTON TOWER	LOWER BEECHES RD	B31	9	36	AFC-WATES	1960	19JAN59	12JUN60	584/717	1014	73	
TENBURY HOUSE	SHELDON HEATH RD	B26	9	34	C & B INFILL	1965	10JUN63	03AUG62	517/797	1308	290	
TENBY TOWER	WILLETS ROAD	B31	9	36	AFC-FRAM	1961	18FEB59	26JUN59	611	707	86	
TENNYSON HOUSE	FAIRFAX ROAD	B31	10	37	INSITU LP	1964	01JUN63	31MAY63	806	1008	383	
TERNHILL HOUSE	HALFPENNY FIELD	B35	11	42	11/F/64	1966	21MAR65	11NOV65	899	1076	9	
TEVIOT TOWER	MOSBOROUGH CRES	B19	16	59	HB/58/16	1962	14SEP60	05OCT61	659/834	1213	152	
THAMES TOWER	CROMWELL STREET	B7	16	90	HB/58/16	1961	21SEP59	04JUN59	644	1345	106	
TOPCLIFFE HOUSE	HAWKINS DRIVE	B35	11	42	11/F/64	1967	29NOV64	09SEP65	910	1377	9	
TRENT TOWER	DUDDESTON MANOR	B7	16	32	16/F/62	1966	17JAN65	07FEB65	805	917	19	
TRIDENT HOUSE	FARNBOROUGH ROAD	B35	11	42	11/F/64	1966	11JAN65	20NOV65	894	1019	165	
TRURO TOWER	LEDBURY CLOSE	B15	16	90	TERSON	1965	31DEC62	06JUL62	784/800	1016	38	
TWEED TOWER	BIRCHFIELD ROAD	B19	16	90	HB 58/16	1962	11JAN60	03SEP60	684	1007	167	
VANCOUVER HOUSE	BENMORE AVENUE	B5	11	40	RB/11/62	1967	11APR65	16FEB65	785	1029	149	
VANGUARD HOUSE	FARNBOROUGH ROAD	B35	11	42	11/F/62	1966	14MAY64	09NOV64	860	1019	210	
VICTOR TOWER	BLOOMSBERRY ST	B7	20	116	20/F/62	1969	19JUL68	20NOV69	1465	1350	34	
VISCOUNT HOUSE	FARNBOROUGH ROAD	B35	11	41	11/F/62	1966	14MAY64	09NOV64	860	1019	156	
VULCAN HOUSE	FARNBOROUGH ROAD	B35	11	42	11/F/64	1967	06JUN65	06OCT66	897	1019	9	
WALTHAM HOUSE	ICKNIELD STREET	B18	8	32	LAINGS	1960	01DEC58	13NOV58	616	1344	159	
WARD END HOUSE	WASHWOOD HEATH	B8	9	36	AFC-BISON	1962	05JUN61	09JUN61	AFC5	1014	130	
WAREHAM HOUSE	BROMPTON POOL RD	B28	8	32	AFC-BISON	1960	09DEC58	22OCT58	612	1024	175	
WARSTONE TOWER	EROMFORD DRIVE	B34	20	116	NO FINES	1967	28MAR68	25JUN66	944	1009	241	

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BLOCK NAME	ROAD NAME	P/C	Ht	Dw.	CONST.TYPE	ACQ. YEAR	START DATE	BUILDG. REGS.	File Reference OR.Con	SD	CAN	REMARKS
WELLESBOURNE TOW	HOPE STREET	B5	16	93	TERSON	1965	31DEC62	06JUL62	786	1302	144	
WELLINGTON TOWER	WILLETS ROAD	B31	9	36	AFC FRAM	1964	18FEB59	26JUN59	611	737	87	
WELLINGTON TOWER	WELSH HOUSE FARM	B32	9	36	WATES C & B	1961	07SEP62	02JUL62	793	1337	209	
WELLS TOWER	RODNEY CLOSE	B16	16	93	TERSON	1965	31DEC62	06JUL62	784.923	1016	190	
WENDOVER HOUSE	SHIFNAL WAY	B31	11	42	11/F/64	1968	18APR67		1091	1384	94	
WHITBOURNE HOUSE	CLOVER LEA ROAD	B8	6	30	NO FINES Y	1955	24MAY54	20JAN54	335	1223	124	
WICKETS TOWER	WYATT CLOSE	B5	20	116	20/F/66	1967	26OCT66	13NOV66	1128	916	19	
WICKHAM HOUSE	GREAT LISTER ST	B7	6	39	LAING CROSSW	1957	18APR56	09APR56				
WILLMOTT COURT	STEPHENS RD	B76	9	52	LIFT SLAB	1965			SC1	1034	353	
WILLOW HOUSE	VAUXHALL ROAD	B7	9	35	C & B INFILL	1964	17SEP62	20OCT64	790	1363	349	
WILMCOTE TOWER	UPPER HIGHGATE	B12	20	116	NO FINES	1967	24OCT65	10SEP65	917/119	1343	053	
WINDRUSH HOUSE	LEY HILL FARM	B31	8	40	NO FINES Y	1957	15JAN55	01JUN64	476	1106	C1	
WINSLOW HOUSE	BUSHWOOD ROAD	B29	5	30	AFC-BISON	1961	14SEP59	21OCT58	AFC4	1323	147	
WOODSTOCK HOUSE	HOLLYBANK ROAD	B14	6	30	NO FINES Y	1955	01JAN54	18MAR54	299	1016		
WORDSWORTH HOUSE	FAIRFAX ROAD	B31	10	37	INSITU LF	1964	01JUN63	31MAY63	806	1036	385	

Appendix III

Physical Appraisal Tree

11.STRUCTURAL APPRAISAL	111.FOUNDATION & BASEMENT	1111.Ground Movements &Settlement
		1112.Distortion/Bowing of Basement Beams
		1113.Distortion/Bowing of Basement Floors
		1114.Reinforcement in Basement Concrete
		1115.Ability to Resist Water Penetration
		1116.Ground Constituents & Chemical Attack
	112.EXTERNAL LOADING PANELS	1121.Bowing of the Panels
		1122.Cracking of the Panels
		1123.Movement at the Connections
		1124.Reinforcement in Panel Concrete
		1125.Spalling of Panel Concrete
	113.INTERNAL WALL PANELS	1131.Bowing of the Panels
		1132.Cracking of the Panels
		1133.Movement at the Connections
		1134.Reinforcement in Panels Concrete
		1135 Spalling of Panels Concrete
	114.FLOOR UNITS	1141.Cracking of Covering Screed
		1142.Cracking of Ceiling Finishes
		1143.Movement at the Connections
		1144.Cracking in the Floor Panels
		1145.Bowing of the Floor Panels
		1146.Reinforcement in the Floor Concrete
	115. STRUCTURAL CONNECTIONS	1151.Joints Opening/Closing
		1152.Differential Movement of the Joints
		1153.Structural Capability of the Joints
		1154.Joints Materials
		1155.Ties in the Joints
	116.ROOF &PARAPET	1161.Water Pentration
		1162.Bowing of Roof Units
		1163.Cracking of Ceiling Below
		1164.Condition of The Topping
		1165.Reinforcement of The Concrete
		1166.Condition of Parapet
	117.STAIRCASE	1171.Stability of The Staircase
		1172.Cracking at Stair/Wall Joint
		1173.Cracking of The Screed
		1174.Movement at Connections
		1175.Reinforcement in the Concrete
		1176.Condition of Guard Rails
	118.LIFT SHAFT	1181.Cracking of the Lift Shaft
		1182.Bowing of the Lift Shaft
		1183.Movement at Connections
		1184.Stability of The Lift Shaft
		1185.Reinforcement in the Concrete

12.FINISHES APPRAISAL

- 121.EXTERNAL CLADDING
  - 1211.Differential Movement
  - 1212.Bowing of The Cladding Units
  - 1213.Cracking of The Cladding Units
  - 1214.Spalling and Impact Damage
  - 1215.Number and Condition of Wall Ties
  - 1216.The Condition of Joints
  - 1217.Water-Tight Joints
- 122.EXTERNAL FIXTURES
  - 1221.Door Fabric and Furniture
  - 1222.Fixing of Frames to Openings
  - 1223.Door &Window Sealent
  - 1224.Operation of Doors & Windows
  - 1225.Window Fabric and Furniture
  - 1226.Fixing of Window Frames to Openings
- 123.INTERNAL FINISHES
  - 1231.Plasterworks
  - 1232.Ceiling Finishes
  - 1233.Painting Works
  - 1234.Condition of Floor Tiles
  - 1235.Carpet Condition
  - 1236.Screed Condition
  - 1237.Wall Covering
- 124.INTERNAL FIXTURES
  - 1241.Door Fabric and Furniture
  - 1242.Fixing of Frames to Openings
  - 1243.Operation of Doors & Windows
  - 1244.Condition of Kitchen Units
  - 1245.Facilities Condition
- 125.COMMUNAL AREAS
  - 1251.Front and Rear Main Doors
  - 1252.Decorations to Ground Floor Loppy
  - 1253.Condition of Landings
  - 1254.Refuse Chute-Room Condition
  - 1255.Safety System (fire,..) Condition
  - 1256.Security Systems
  - 1257.Caretaker Services

13. SERVICES APPRAISAL	131.WATER SUPPLY	1311.Hot Water Availability 1312.Cold Water Pressure 1313.Pipework Condition 1314.Fixing Pipework to Fabric 1315.Sinks &Taps Condition 1316.Bath Condition 1317.Hot & Cold Water Storage
	132.PLUMBING & DRAINAGE	1321.Pipework Condition 1322.Pipework Fixing Condition 1323.Operation/Condition of W.C. 1324.Sinks and Taps Operation 1325.Bath Operation
	133.HEATING	1331.Response 1332.Heat Output 1333.Breakdowns 1334.Heating Units/Radiators 1335.Thermostat/Time Control
	134.ELECTRICITY	1341.Adequate Number of Units 1342.Sockets & Switches Condition 1343.Light Units Condition 1344.Wiring Condition(Including Safety) 1345.Mains Supply Condition
	135.LIFTS	1351.Lift Operation 1352.Lift Breakdown 1353.Appearance of Lift Doors 1354.Appearance of Carriage 1355.Lift Gear Condition 1356.Lift Motor Room Condition
	136.GAS SUPPLY	1361.Main Supply Unit Condition 1362.Main Supply Pipework Condition 1363.Distribution Pipework Condition 1364.Cookers & Heaters Condition 1365.Boilers Condition 1366.Condition of Fixings to Pipework
	137.VENTILATION	1371.Opening Ventilation Availability 1372.Mechanical Ventilation 1373.Permanent Ventilation 1374.Mould,Fungi Growth 1375.Condensation Problems
	138.INSULATION	1381.Sound Transmission 1382.Sound from Adjacent Flats 1383.Sound from External Corridors 1384.Sound from with Flat 1385.Heat Loss Through External Walls 1386.Heat Loss Through Internal Walls 1387.Provision of Double Glazing

14. ENVIRONMENT

APPRAISAL

141.EXTERNAL YARDS	1411.Paving and Gutters 1412.Boundary Fencing 1413.Drainage 1414.Adequate Lighting
142.GREEN AREAS	1421.Grassed Areas 1422.Trees and Shrubs 1423.Drainage 1424.Footpath 1425.Adequate Lighting
143.PARKING & GARAGES	1431.Pavement Materials 1432.Entrance to the Car Park 1433.Drainage and Topography 1434.Garages Materials 1435.Adequate Number of Spaces 1436.Adequate Lighting
144.FACILITIES	1441.Existing Childrens Play Area 1442.Adequate Shopping Facilities 1443.Existing Bus or Train Services 1444.Public Telephone & Post Box 1445.Adequate Health Facilities 1446.Adjacent Areas

Appendix IV

Physical Appraisal Form

BLOCK NAME : HEIGHT :

ADDRESS : CONST. TYPE :

11. STRUCTURE

111.FOUNDATION & BASEMENTS :	E	D	C	B	A	Remarks
1111.Ground Movements &Settlement						
1112.Distortion/Bowing of Basement Beams or Walls						
1113.Distortion/Bowing of Basement Floors						
1114.Reinforcement in Basement Concrete						
1115.Ability to Resist Water Pentration						
1116.Ground Constituents & Chemical Attack						

112.EXTERNAL LOADING PANELS :	E	D	C	B	A	Remarks
1121.Bowing of The Panels						
1122.Cracking of The Panels						
1123.Movement at The Connections						
1124.Reinforcement in Panel Concrete						
1125.Spalling of Panel Concrete						

113.INTERNAL WALL PANELS :	E	D	C	B	A	Remarks
1131.Bowing of The Panels						
1132.Cracking of The Panels						
1133.Movement at The Connections						
1134.Reinforcement in Panels Concrete						
1135.Spalling of Panels Concrete						

114.FLOOR UNITS :	E	D	C	B	A	Remarks
1141.Cracking of Covering Screed						
1142.Cracking of Ceiling Finishes						
1143.Movement at The Connections						
1144.Cracking in The Floor Panels						
1145.Bowing of The Floor Panels						
1146.Reinforcemebt in The Floor Concrete						

A:As New **B:Good** **C:Average** **D:Bad** **E:Unsafe**

BLOCK NAME : **HEIGHT :**

ADDRESS : **CONST. TYPE :**

11. STRUCTURE :

115.STRUCTURAL CONNECTIONS :	E	D	C	B	A	Remarks
1151.Joints Opening/Closing						
1152.Differential Movement of Joints						
1153.Structural Capability of the Joints						
1154.Joints Materials						
1155.Ties in the Joints						

116.ROOFS & PARAPET :	E	D	C	B	A	Remarks
1161.Water Pentration						
1162.Bowing of Roof Units						
1163.Cracking of Ceiling Below						
1164.Condition of The Topping						
1165.Reinforcement of The Concrete						
1166.Condition of Parapet						

117.STAIRCASE :	E	D	C	B	A	Remarks
1171.Stability of The Staircase						
1172.Cracking at Stair/Wall Joint						
1173.Cracking of The Screed						
1174.Movement at Connections						
1175.Reinforcement in the Concrete						
1176.Condition of Guard Rails						

118.LIFT SHAFT :	E	D	C	B	A	Remarks
1181.Cracking of the Lift Shaft						
1182.Bowing of the Lift Shaft						
1183.Connections Movement						
1184.Stability of the Lift Shaft						
1185.Reinforcement in the Concrete						

A: As New **B:Good** **C:Average** **D:Bad** **E:Unsafe**

BLOCK NAME :

HEIGHT :

ADDRESS :

CONST. TYPE :

12. FINISHES APPRAISAL :

121. EXTERNAL CLADDING	E	D	C	B	A	Remarks
1211.Differential Movement						
1212.Bowing of the Cladding Units						
1213.Cracking of the Cladding Units						
1214.Spalling and Impact Damage						
1215.Number and Condition of Wall Ties						
1216.The Condition of Joints						
1217.Water-Tight Joints						

122.EXTERNAL FIXTURES	E	D	C	B	A	Remarks
1221.Door Fabric and Furniture						
1222.Fixing of Frames to Openings						
1223.Door &Window Sealent						
1224.Operation of Doors & Windows						
1225.Window Fabric and Furniture						
1226.Fixing of Window Frames to Open.						

123.INTERNAL FINISHES	E	D	C	B	A	Remarks
1231.Plasterworks						
1232.Ceiling Finishes						
1233.Painting Works						
1234.Condition of Floor Tiles						
1235.Carpet Condition						
1236.Screed Condition						
1237.Wall Covering						

124.INTERNAL FIXTURES :	E	D	C	B	A	Remarks
1241.Door Fabric and Furniture						
1242.Fixing of Frames to Openings						
1243.Operation of Doors & Windows						
1244.Condition of Kitchen Units						
1245.Facilities Condition						

125. COMMUNAL AREAS:	E	D	C	B	A	Remarks
1251.Front and Rear Main Doors						
1252.Decorations to Ground Floor Loppy						
1253.Condition of Landings						
1254.Refuse Chute-Room Condition						
1255.Safety System (fire,..) Condition						
1256.Security Systems						
1257.Caretaker Services						

BLOCK NAME : **HEIGHT :**

ADDRESS : **CONST. TYPE :**

13. SERVICES APPRAISAL :

131.WATER SUPPLY :	E		D		C		B		A		Remarks
1311.Hot Water Availability											
1312.Cold Water Pressure											
1313.Pipework Condition											
1314.Fixing Pipework to Fabric											
1315.Sinks &Taps Condition											
1316.Bath Condition											
1317.Hot & Cold Water Storage											

132.PLUMBING & DRAINAGE :	E		D		C		B		A		Remarks
1321.Pipework Condition											
1322.Pipework Fixing Condition											
1323.Operation/Condition of W.C.											
1324.Sinks and Taps Operation											
1325.Bath Operation											

133.HEATING :	E		D		C		B		A		Remarks
1331.Response											
1332.Heat Output											
1333.Breakdowns											
1334.Heating Units/Radiators											
1335.Thermostat/Time Control											

134.ELECTRICITY :	E		D		C		B		A		Remarks
1341.Adequate Number of Units											
1342.Sockets & Switches Condition											
1343.Light Units Condition											
1344.Wiring Condition(Including Safety)											
1345.Mains Supply Condition											

A:As New **B:Good** **C:Average** **D:Bad** **E:Unsafe**

BLOCK NAME : **HEIGHT :**

ADDRESS : **CONST. TYPE :**

13. SERVICES :

135. LIFTS :	E	D	C	B	A	Remarks
1351.Lift Operation						
1352.Lift Breakdown						
1353.Appearance of Lift Doors						
1354.Appearance of Carriage						
1355.Lift Gear Condition						
1356.Lift Motor Room Condition						

136. GAS SUPPLY :	E	D	C	B	A	Remarks
1361.Main Supply Unit Condition						
1362.Main Supply Pipework Condition						
1363.Distribution Pipework Condition						
1364.Cookers & Heaters Condition						
1365.Boilers Condition						
1366.Condition of Fixings to Pipework						

137. VENTILATION :	E	D	C	B	A	Remarks
1371.Opening Ventilation Availability						
1372.Mechanical Ventilation						
1373.Permanent Ventilation						
1374.Mould,Fungi Growth						
1375.Condensation Problems						

138.INSULATION :	E	D	C	B	A	Remarks
1381.Sound Transmission from Outside						
1382.Sound from Adjacent Flats						
1383.Sound from External Corridors						
1384.Sound from with Flats						
1385.Heat Loss Through External Walls						
1386.Heat Loss Through Internal Walls						
1387.Provision of Double Glazin						

A:As New **B:Good** **C:Average** **D:Bad** **E:Unsafe**

BLOCK NAME : **HEIGHT :**

ADDRESS : **CONST. TYPE :**

14. ENVIRONMENT :

141.EXTERNAL YARDS :	E		D		C		B		A		Remarks
1411.Paving and Gutters											
1412.Boundary Fencing											
1413.Drainage											
1414.Adequate Lighting											

142.GREEN AREAS	E		D		C		B		A		Remarks
1421.Grassed Areas											
1422.Trees and Shrubs											
1423.Drainage											
1424.Footpath											
1425.Adequate Lighting											

143.PARKING & GARAGES	E		D		C		B		A		Remarks
1431.Pavement Materials											
1432.Entrance to the Car Park											
1433.Drainage and Topography											
1434.Garages Materials											
1435.Adequate Number of Spaces											
1436.Adequate Lighting											

144.FACILITIES	E		D		C		B		A		Remarks
1441.Existing of Childrens Play Area											
1442.Adequate Shopping Facilities											
1443.Existing Bus or Train Services											
1444.Public Telephone & Post Box											
1445.Adequate Health Facilities											
1446.Adjacent Areas											

A:As New **B:Good** **C:Average** **D:Bad** **E:Unsafe**

Appendix V

Physical Appraisal Calculation Sheets

(The calculation model of the Physical Appraisal Approach; physical, structural, finishes, services and environmental Condition scores for the Normansell Tower are calculated, as shown)

Block Name :________________

Address:____________________

Sheet 1: STRUCTURE

	11i1	11i2	11i3	11i4	11i5	11i6
111	0.25	0.25	0.15	0.15	0.10	0.10
112	0.20	0.20	0.20	0.20	0.20	/
113	0.20	0.20	0.20	0.20	0.20	/
114	0.10	0.10	0.20	0.20	0.20	0.20
115	0.15	0.20	0.20	0.25	0.20	/
116	0.15	0.25	0.15	0.15	0.10	0.20
117	0.20	0.20	0.10	0.25	0.10	0.15
118	0.20	0.20	0.20	0.20	0.20	/

[A]: Sub-Elements Cost Weighting Matrix

X

1	2	3	4	5	6
					/
					/
					/
					/

[X]: Sub-Element Average Quality Score Matrix

=

{Y}		{B}
		0.15
		0.15
		0.15
		0.15
	X	0.10
		0.10
		0.10
		0.10

{Y}:Elements Score Matrix

{B}:Elements Cost Wt. Matrix

= [ ]

Zi : Structural Appraisal Score

$$Yi = \sum_{j=1}^{n} Aij * Xij$$

$$Zk = \sum_{i=1}^{m} Bki * Yi$$

Block Name : ____________

Address : ____________

Sheet No. 2 : FINISHES

	12i1	12i2	12i3	12i4	12i5	12i6	12i7
1 2 1	0.15	0.15	0.15	0.10	0.15	0.20	0.10
1 2 2	0.20	0.10	0.20	0.20	0.20	0.10	
1 2 3	0.15	0.15	0.15	0.15	0.15	0.10	0.15
1 2 4	0.30	0.15	0.15	0.25	0.15		
1 2 5	0.15	0.15	0.15	0.15	0.15	0.10	0.15

[A]: Sub-items Weighting Cost Matrix

X

[X]: Sub-items Average Quality Score Matrix

=

{Y}: Items Score Matrix

X

0.25
0.20
0.20
0.20
0.15

{B}: Items Weighting Cost Matrix

= ☐

Zi: Finishes Appraisal Score

$$Yi = \sum_{j=1}^{n} Aij * Xij$$

$$Zk = \sum_{i=1}^{m} Bki * Yi$$

Sheet 3: SERVICES

Block Name :________________

Address:____________________

	13i1	13i2	13i3	13i4	13i5	13i6	13i7
131	0.10	0.15	0.15	0.15	0.15	0.15	0.15
132	0.20	0.20	0.20	0.20	0.20	/	/
133	0.15	0.10	0.10	0.50	0.15	/	/
134	0.15	0.15	0.20	0.25	0.25	/	/
135	0.10	0.10	0.15	0.15	0.25	0.25	/
136	0.15	0.15	0.15	0.20	0.20	0.15	/
137	0.20	0.20	0.20	0.20	0.20	/	/
138	0.15	0.15	0.15	0.15	0.15	0.10	0.15

[A]: Sub-Items Cost Weighting Matrix

X

1	2	3	4	5	6	7
					/	/
					/	/
					/	/
						/
						/
					/	/

[X]: Sub-Items Average Quality Score Matrix

=

{Y}: Items Score Matrix

X

0.15
0.15
0.10
0.10
0.15
0.15
0.10
0.10

{B}: Items Cost Wt. Matrix

= ☐

Zi : Services Appraisal Score

$$Yi = \sum_{j=1}^{n} Aij * Xij$$

$$Zk = \sum_{i=1}^{m} Bki * Yi$$

Block Name : ____________

Address : ____________

Sheet No.4 : ENVIRONMENTAL

	14i1	14i2	14i3	14i4	14i5	14i6
1 4 1	0.45	0.25	0.15	0.15	/	/
1 4 2	0.30	0.30	-.15	0.15	0.10	/
1 4 3	0.25	0.10	0.15	0.25	0.10	0.15
1 4 4	0.20	0.15	0.15	0.15	0.15	0.20

[A]: Sub-items Weighting Cost Matrix

X

				/	/
					/

[X]: Sub-items Average Quality Score Matrix

=

{Y}: Items Score Matrix

X

0.30
0.25
0.30
0.15

{B}: Items Weighting Cost Matrix

= ☐

Zi: Environmental Appraisal Score

$$Yi = \sum_{j=1}^{n} Aij * Xij$$

$$Zk = \sum_{i=1}^{m} Bki * Yi$$

Block Name : ____________

Sheet No.5 : SUMMARY

Address : ____________

Major Components	Quality Score Z_i	Weighting Cost C_k
11. Structure		0.38
12. Finishes		0.28
13. Services		0.24
14. Environmental		0.10

X = [ ]

F_1: Physical Appraisal Score

Construction Type	
Storeys No.	
Dwellings No.	
Warden	
Caretaker	
Community Room	
Heating System	

$$Fi = \sum_{k=1}^{4} Ck * Zk$$

Notes:

1.

2.

3.

4.

5.

Appendix VI

Physical Appraisal Computer Programme

(The list of computer programme for the Physical Appraisal Approach; quality scores for the Normansell Tower are shown)

```
10   DIM  A1(8,6), A2(5,7), A3(8,7), A4(4,6)
20   DIM  X1(8,6), X2(5,7), X3(8,7), X4(4,6)
30   DIM B1(8), B2(5), B3(8), B4(4)
40   DIM Y1(8), Y2(5), Y3(8), Y4(4)
50   DIM C(4), Z(4), S$(8), Z1$(4)
60   DIM F$(5), SE$(8), EN$(4)
70   LPRINT "PHYSICAL AND ENVIRONMENTAL APPRAISAL"
80   REM
90   REM  READ WEIGHTING MATRICES
100  REM
110  REM  1. STRUCTURAL APPRAISAL  (COST WEIGHTING FOR ELEMENTS &
          SUB-ELEMENTS)
120  REM
130  FOR I= 1 TO 8
140  FOR J= 1 TO 6
150  READ A1(I,J)
160  NEXT J
170  NEXT I
180  FOR I= 1 TO 8
190  READ B1(I)
200  NEXT I
210  FOR I= 1 TO 8
220  READ S$(I)
230  NEXT I
240  DATA  0.25,0.25,0.15,0.15,0.1,0.1,0.2,0.2,0.2,0.2,0.2,0,0.2,0.2,0.2,0.2
250  DATA  0.2,0,0.1,0.1,0.2,0.2,0.2,0.2,0.15,0.2,O.2,0.25,0.2,0,0.15,0.25
260  DATA  0.15,0.15,0.1,0.2,0.2,0.1,0.25,0.1,0.15,0.2,0.2,0.2,0.2,0.2,0
270  DATA  0.15,0.15,0.15,0.15,0.1,0.1,0.1,0.1
280  DATA "FOUNDATION & BASEMENT","EXTERNAL LOADING PANEL"
290  DATA "INTERNAL WALL PANELS","FLOOR PANELS"
300  DATA "STRUCTURAL CONNECTIONS","ROOF & PARAPET"
310  DATA "STAIRCASE","LIFT SHAFT"
320  REM
330  REM  2. FINISHES APPRAISAL  (COST WEIGHTING FOR ITEMS &
          SUB-ITEMS)
340  REM
350  FOR I= 1 TO 5
360  FOR J= 1 TO 7
370  READ A2(I,J)
380  NEXT J
390  NEXT I
400  FOR I= 1 TO 5
410  READ B2(I)
420  NEXT I
430  FOR I= 1 TO 5
440  READ F$(I)
450  NEXT I
460  DATA  0.15,0.15,0.15,0.1,0.15,0.2,0.1,0.2,0.1,0.2,0.2,0.2,0.1,0.,0.15
470  DATA  0.15,0.15,0.15,0.1,0.15,0.3,0.15,0.15,0.25,0.15,O,0,0.15,0.15
480  DATA  0.15,0.15,0.1,0.15,0.25,0.2,0.2,0.2,0.15
490  DATA "EXTERNAL CLADDING","EXTERNAL FIXTURES","INTERAL FINISHES"
500  DATA "INTERNAL FIXTURES","COMMUNAL AREAS"
510  REM
520  REM  3. SERVICES APPRAISAL  (COST WEIGHTING FOR ITEMS &
          SUB-ITEMS)
```

```
530  REM
540  FOR  I= 1 TO 8
550  FOR  J= 1 TO 7
560  READ  A3(I,J)
570  NEXT J
580  NEXT  I
590  FOR  I= 1 TO 8
600  READ  B3(I)
610  NEXT  I
620  FOR I= 1 TO 8
630  READ  SE$(I)
640  NEXT  I
650  DATA   0.1,0.15,0.15,0.15,0.15,0.15,0.2,0.2,0.2,0.2,0.2,0,0
660  DATA   0.15,0.1,0.1,0.5,0.15,0,0,0.15,0.15,0.2,0.25,0.25,0,0
670  DATA   0.1,0.1,0.15,0.15,0.25,0.25,0,0.15,0.15,0.2,0.2,0.15,0
680  DATA   0.2,0.2,0.2,0.2,0.2,0,0,0.15,0.15,0.15,0.15,0.15,0.1,0.15
690  DATA   0.15,0.15,0.1,0.1,0.15,0.15,0.1,0.1
700  DATA "WATER SUPPLY","PLUMBING & DRAINAGE","HEATING"
710  DATA "ELECTRICITY","LIFTS","GAS SUPPLY"
720  DATA "VENTILATION","INSULATION"
730  REM
740  REM    4. ENVIRONMENTAL APPRAISAL   (COST WEIGHTING FOR ITEMS &
            SUB-ITEMS)
750  REM
760  FOR  I= 1 TO 4
770  FOR  J= 1 TO 6
780  READ  A4(I,J)
790  NEXT J
800  NEXT  I
810  FOR  I= 1 TO 4
820  READ  B4(I)
830  NEXT  I
840  FOR I= 1 TO 4
850  READ  EN$(I)
860  NEXT  I
870  DATA   0.45,0.25,0.15,0.15,0,0,0.3,0.3,0.15,0.1,0,0.25,0.1,0.15,0.25
880  DATA   0.1,0.15,0.2,0.15,0.15,0.15,0.2,0.3,0.25,O.3,0.15
890  DATA "EXTERNAL YARDS","GREEN AREAS"
900  DATA "PARKING & GARAGES","FACILITIES"
910  REM
920  REM    READ THE MAIN COMPONENTS WEIGHTING
930  REM
940  FOR  I= 1 TO 4
950  READ  C(I)
960  NEXT  I
970  DATA   0.38,0.28,0.24,0.10
980  REM
990  LPRINT        "************************************************"
1000 LPRINT "                1. STRUCTURAL  APPRAISAL"
1010 LPRINT   "================================================"
1020 L=1
1030 REM
1040 REM    INPUT THE AVERAGE SCORING OF SUB-ELEMENTS AND SUB-ITEMS
1050 REM
1060 FOR  I= 1 TO 8
1070 FOR  J= 1 TO 6
1080 READ  X1(I,J)
```

```
1090 NEXT J
1100 NEXT I
1110 REM
1120 REM    CALCULATION OF Y1
1130 REM
1140 FOR I=1 TO 8
1150 M=0
1160 Y1(I)=0
1170 FOR J=1 TO 6
1180 Y1(I)=Y1(I)=A1(I,J)*X1(I,J)
1190 IF A1(I,J)=0 THEN 1250
1200 IF X1(I,J)=0 THEN 1220
1210 GOTO 1250
1220 M=1
1230 K=1
1240 X=A1(I.J)
1250 NEXT J
1260 IF M=0 THEN 1280
1270 Y1(K)=Y1(K)/(1-X)
1280 NEXT I
1290 REM
1300 REM    CALCULATION OF Z(1)
1310 REM
1320 Z(L)=0
1330 FOR I=1 TO 8
1340 Z(L)=Z(L)+Y1(I)*B1(I)
1350 NEXT I
1360 REM
1370 REM    WRITE THE STRUCTURAL ELEMENT SCORES & THE STRUCTURE SCORE
1380 REM
1390 FOR I=1 TO 8
1400 LPRINT " THE SCORE OF ";S$(I);" IS ";(Y1(I))
1410 NEXT I
1420 LPRINT     "***************************************************"
1430 LPRINT " THE STRUCTURAL QUALITY SCORE IS ",(Z(L))
1440 LPRINT     "***************************************************"
1450 L=2
1460 LPRINT "                 2. FINISHES  APPRAISAL"
1470 LPRINT  "================================================="
1480 FOR I=1 TO 5
1490 FOR J=1 TO 7
1500 READ X2(I,J)
1510 NEXT J
1520 NEXT I
1530 REM
1540 REM    CALCULATION OF Y2
1550 REM
1560 FOR I=1 TO 5
1570 M=0
1580 Y2(I)=0
1590 FOR J=1 TO 7
1600 Y2(I)=Y2(I)=A2(I,J)*X2(I,J)
1610 IF A2(I,J)=0 THEN 1670
1620 IF X2(I,J)=0 THEN 1640
1630 GOTO 1670
1640 M=1
1650 K=1
```

```
1660 X=A2(I.J)
1670 NEXT J
1680 IF M=0 THEN 1700
1690 Y2(K)=Y2(K)/(1-X)
1700 NEXT I
1710 REM
1720 REM   CALCULATION OF Z(2)
1730 REM
1740 Z(L)=0
1750 FOR I=1 TO 5
1760 Z(L)=Z(L)+Y2(I)*B2(I)
1770 NEXT I
1780 REM
1790 REM   WRITE THE FINISHES ITEMS SCORES & THE FINISHES SCORE
1800 REM
1810 FOR I=1 TO 5
1820 LPRINT " THE SCORE OF ";F$(I);" IS ";(Y2(I))
1830 NEXT I
1840 LPRINT      "*********************************************"
1850 LPRINT " THE FINISHES QUALITY SCORE IS ",(Z(L))
1860 LPRINT      "*********************************************"
1870 L=3
1880 LPRINT "              3. SERVICES  APPRAISAL"
1890 LPRINT  "=============================================="
1900 FOR  I=1 TO 8
1910 FOR J=1 TO 7
1920 READ X3(I,J)
1930 NEXT J
1940 NEXT I
1950 REM
1960 REM   CALCULATION OF Y3
1970 REM
1980 FOR  I=1 TO 8
1990 M=0
2000 Y3(I)=0
2010 FOR J=1 TO 7
2020 Y3(I)=Y3(I)=A3(I,J)*X3(I,J)
2030 IF A3(I,J)=0 THEN 2060
2040 IF X3(I,J)=0 THEN 2090
2050 GOTO 2090
2060 M=1
2070 K=1
2080 X=A3(I.J)
2090 NEXT J
2100 IF M=0 THEN 2120
2110 Y3(K)=Y3(K)/(1-X)
2120 NEXT I
2130 REM
2140 REM   CALCULATION OF Z(3)
2150 REM
2160 Z(L)=0
2170 FOR I=1 TO 8
2180 Z(L)=Z(L)+Y3(I)*B3(I)
2190 NEXT I
2200 REM
2210 REM   WRITE THE SERVICE ITEMS SCORES & THE SERVICE SCORE
2220 REM
```

```
2230 FOR I=1 TO 8
2240 LPRINT " THE SCORE OF ";SE$(I);" IS ";(Y3(I))
2250 NEXT I
2260 LPRINT "***********************************************"
2270 LPRINT " THE SERVICE QUALITY SCORE IS ",(Z(L))
2280 LPRINT "***********************************************"
2290 L=4
2300 LPRINT "                4. ENVIRONMENT APPRAISAL"
2310 LPRINT "================================================"
2320 FOR I=1 TO 4
2330 FOR J=1 TO 6
2340 READ X4(I,J)
2350 NEXT J
2360 NEXT I
2370 REM
2380 REM   CALCULATION OF Y4
2390 REM
2400 FOR I=1 TO 4
2410 M=0
2420 Y4(I)=0
2430 FOR J=1 TO 6
2440 Y4(I)=Y4(I)=A4(I,J)*X4(I,J)
2450 IF A4(I,J)=0 THEN 2510
2460 IF X4(I,J)=0 THEN 2480
2470 GOTO 2510
2480 M=1
2490 K=1
2500 X=A4(I.J)
2510 NEXT J
2520 IF M=0 THEN 1700
2530 Y4(K)=Y4(K)/(1-X)
2540 NEXT I
2550 REM
2560 REM   CALCULATION OF Z(4)
2570 REM
2580 Z(L)=0
2590 FOR I=1 TO 4
2600 Z(L)=Z(L)+Y4(I)*B4(I)
2610 NEXT I
2620 REM
2630 REM   WRITE THE ENVIRN. ITEMS SCORES & THE ENVIRONMENT SCORE
2640 REM
2650 FOR I=1 TO 4
2660 LPRINT " THE SCORE OF ";EN$(I);" IS ";(Y4(I))
2670 NEXT I
2680 LPRINT "***********************************************"
2690 LPRINT " THE ENVIRONMENT QUALITY SCORE IS ",(Z(L))
2700 LPRINT "***********************************************"
2710 REM
2720 REM   THE FINAL PHYSICAL QUALITY SCORE CALCULATION
2730 REM
2740 PH=0
2750 FOR I=1 TO 4
2760 PH=(PH+C(I)*Z(I))
2770 NEXT I
2780 LPRINT "THE FINAL PHYSICAL QUALITY SCORE IS ",PH
2790 REM
```

```
2800 REM   DATA OF THE AVERAGE SCORES OF SUB-ELEMENTS & SUB-ITEMS
2810 REM
2820 DATA  85,85,85,85,   75,65,75,85,75,85,85,0,75,85,65,75,65,0,65
2830 DATA  55,65,75,85,85,45,55,65,55,65,0,55,75,65,55,75,75,75,55
2840 DATA  55,65,75,65,75,85,75,85,75,0,75,75,65,75,0,75,45,35,45
2850 DATA  35,55,35,55,0,45,55,45,45,35,45,65,35,35,35,45,55,0,0,45
2860 DATA  45,55,55,35,65,0,65,65,65,55,55,55,65,55,55,65,65,65,0,0
2870 DATA  65,55,55,65,65,0,0,65,45,45,55,65,0,0,55,55,25,25,45,45,0
2880 DATA  65,65,65,55,45,55,0,65,65,45,55,35,0,0,45,65,55,55,35,55
2890 DATA  0,55,55,45,65,0,0,55,45,55,45,65,0,65,55,55,65,55,55,45
2900 DATA  65,75,55,75,55
2910 END
```

Output example from the Physical Appraisal Computer Programme for the Normansell tower block:

```
BLOCK NAME:         NORMANSELL TOWER
==================================================
PHYSICAL APPRAISAL APPROACH
**************************************************
        1.      STRUCTURAL APPRAISAL
==================================================
THE SCORE OF FOUNDATION & BASEMENT        IS    82
THE SCORE OF EXTERNAL LOADING PANELS      IS    81
THE SCORE OF INTERNAL WALL PANELS         IS    73
THE SCORE OF FLOOR PANELS                 IS    74
THE SCORE OF STRUCTURAL CONNECTIONS       IS    58
THE SCORE OF ROOF & PARAPET               IS    68
THE SCORE OF STAIRCASE                    IS    65
THE SCORE OF LIFT SHAFT                   IS    79
**************************************************
THE STRUCTURAL QUALITY SCORE              IS    74
**************************************************
        2.      FINISHES APPRAISAL
==================================================
THE SCORE OF EXTERNAL CLADDING            IS    70
THE SCORE OF EXTERNAL FIXTURES            IS    42
THE SCORE OF INTERNAL FINISHES            IS    48
THE SCORE OF INTERNAL FIXTURES            IS    41
THE SCORE OF COMMUNAL AREAS               IS    50
**************************************************
THE FINISHES QUALITY SCORE                IS    51
**************************************************
        3.      SERVICES APPRAISAL
==================================================
THE SCORE OF WATER SUPPLY                 IS    61
THE SCORE OF PLUMBING & DRAINAGE          IS    61
THE SCORE OF HEATING                      IS    63
THE SCORE OF ELECTRICITY                  IS    56
THE SCORE OF LIFTS                        IS    41
THE SCORE OF GAS SUPPLY                   IS    58
THE SCORE OF VENTILATION                  IS    53
THE SCORE OF INSULATION                   IS    52
**************************************************
THE SERVICES QUALITY SCORE                IS    56
**************************************************
        4.      ENVIRONMENT APPRAISAL
==================================================
THE SCORE OF EXTERNAL YARDS               IS    55
THE SCORE OF GREEN AREAS                  IS    52
THE SCORE OF PARKING & GARAGES            IS    60
THE SCORE OF FACILITIES                   IS    61
**************************************************
THE ENVIRONMEMTAL QUALITY SCORE           IS    56
************************************************************
THE FINAL PHYSICAL QUALITY SCORE          IS    62
```

Appendix VII

The Social Appraisal Questionnaire

APPRAISAL QUESTIONNAIRE

This questionnaire has been designed to examine your satisfaction of the dwelling, block and estate in which you live.

This questionnaire forms part of a research project being undertaken at Aston University. Any information which is given will be treated in the strictest confidence.

The questionaire takes the form of a series of short statements. Please indicate that statement which best describes how you feel. Please answer all questions.

If you have any questions please telephone Mr. A. Y. Thannon on 021-3593611 Ext.4389.

Aston University
October 1987

PART ONE : Biographical Data

Please complete this part for record purposes.

1. Block Name :..

2. Floor Number : ....

3. Dwelling Number : ....

		Please Circle Number
4. Size of Dwelling :	One Bedroom	1
	Two Bedroom	2
5. Sex of Respondent:	Male	1
	Female	2
6. Age of Respondent:	18 - 25 years	1
	26 - 40 years	2
	41 - 64 years	3
	65 years or over	4
7. Marital Status :	Single	1
	Married	2
	Other (please state)	3

8. Occupation (Specify): ....

9. How many people live at this address? ....

10. Number of children (under 16 Years) living at this address: ......

11. Number of adults living at this address: ....

12. How long have you lived at this block? ....

PART TWO : Dwelling Appraisal

Please tick (/) the relevent box for that statement which best describes your level of satisfaction.

21. Living Room :

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
211. There are no problems arranging and fitting furniture into the living room.					
212. The physical layout of the living room is good.					
213. The number of doors and windows in the living room are satisfactory for daylighting and ventilation.					
214. The living room is large enough for day to day use.					
215. You are bothered by noise in the living room.					
216. The living room can be kept warm in winter.					

22. Bed Room(s) :

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
221. There are no problems arranging and fitting furniture into the bed room(s).					
222. The physical layout of the bed room(s) is good.					
223. There is sufficient sun light on the bed room(s).					
224. The sound insulation is good due to the bed room (s) position.					
225. There is enough storage space in the bed room(s).					

23. Kitchen :

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
231. There are no problems arranging and fitting furniture and appliances into the kitchen.					
232. There is enough storage space in the kitchen.					
233. The working arrangement in the kitchen is satisfactory.					
234. In the kitchen, there are adequate means to prevent cooking smells reaching other part of the dwelling.					
235. The kitchen is large enough.					
236. The kitchen units are satisfactory.					

24. Bathroom & W.C. :

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
241. The bathroom & W.C. are adequate.					
242. There is adequate space in the bathroom & W.C..					
243. The bathroom & W.C. fittings are satisfactory.					
244. The position of the bathroom & W.C. allow(s) good ventilation.					
245. There is adequate space to open the door and enter easily.					

25. The Dwelling (In general) :

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
251. The physical layout of the dwelling is good.					
252. The location of this dwelling within the building is good.					
253. There are no problems living in this particular dwelling.					
254. If I had to move away from this dwelling, I would be glad.					
255. There are no problems within the corridor.					
256. There are no places where children can play in the dwelling.					

257. In low-rise building, do you prefer the same layout of the dwelling?

Yes.................... 1
No..................... 2
Don't Know....... 3

258. What are the main problems with this dwelling? ....

....

....

....

259. How do you think the dwelling could be improved? ....

....

....

....

....

PART THREE : Block Appraisal

Please tick (/) the relevent box for that statement which best describes your level of satisfaction.

31. Finishes :

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
311. The physical condition of the external cladding is in good repair.					
312. The plaster and wall coverings are in good condition.					
313. The doors and windows are generally in good condition.					
314. The internal fixtures are generally good.					
315. There are no problems with the condition of refuse chute-room.					
316. There are no problems with the operation of the doors and windows.					
317. Front and rear main doors are in good repair.					
318. The communal areas are generally in good condition.					
319. The security system in the block is properly used.					

32. Services :

321. The system of heating used is adequate.					
322. The water supply is generally adequate.					
323. There are no problems with the plumbing and drainage systems.					
324. The number of switches and power points are satisfactory.					
325. The lift(s) does work very well.					
326. The form of ventilation used is efficient.					
327. Noise is not a problem living in this particular dwelling.					
328. There is no problem with the gas supply (if any).					
329. In general the services supplied in this block are adequate.					

33. Environment :

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
331. Public services on the estate are adequate.					
332. The physical layout of the area around the block is good.					
333. The green areas around the block are in good condition.					
334. Parking facilities on the estate are good.					
335. The footpath to and from the block are in good condition.					
336. There are enough facilities for children to play on this estate.					
337. There are no health problems associated with living here.					
338. There are adequate health and shopping facilities around the block					
339. Children playing around here make a problem.					

34. The Block (in general) :

	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
341. The physical layout of the block is generally poor.					
342. Facilities provided within the block are good.					
343. The block is well situated within this area of the estate.					
344. There is no privacy living in this block.					
345. It feels unsafe walking about different parts of the building at night.					
346. In general, the estate is satisfactory to live in.					
347. In general, the neighbours are friendly people.					
348. There is no vandalism on this block.					

349. How do you think the block could be improved? ....

....

PART FOUR : General Information

This part of the questionnaire allows you to say anything you wish about the accommodation you are living in. Some general quations are asked below to help you to express your personal views.

1. What sort of accommodation would you ideally like to live in? ....
....

2. What do you think the maximum storey height of blocks should be? ....
....

2a. Which floor would you most like to live on? ....

3. Do you have any comments to make about the structural condition of the block ?
....
....

4. Do you use the central heating system of the building?

Yes	1
No	 2
Don't Know	 3

4a. If No, What sort of heating system do you use? ....
....

5. Write down any comments that you like to make about:

a. The dwelling :...
....
....

b. The block :...
....
....

c. The estate : ....
....

6. Do you have any comments on the questionnaire? ....
....

Thank you for answering this questionnaire

Appendix VIII

The Five Likert scale results for dwelling and block categories

TABLE VIII-1:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR LIVING ROOM.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	STRONGLY SATISFY	SATISFY	IN BETWEEN	DISSATISFY	STRONGLY DISSATISFY	%NO COMMENT
1.	LAPWORTH HO.	13	19	8.3	58.3	12.5	6.3	14.6	-
2.	DURHAM TOWER	20	18	10.0	68.3	5.0	10.0	6.7	-
3.	STOKESAY HO.	11	23	15.7	47.1	11.8	12.7	12.7	-
4.	NETLEY HOUSE	11	23	6.7	68.3	5.8	13.3	5.8	-
5.	WHEELDON HO.	11	17	10.3	75.3	3.4	5.2	5.7	-
6.	WESTON HOUSE	13	21	7.4	46.3	16.7	18.5	11.1	-
7.	WOBURN HOUSE	13	18	12.5	52.8	15.3	12.5	6.9	-
8.	BALDWIN HO.	15	20	10.4	52.1	16.7	10.4	10.4	-
9.	ESSINGTON HO.	15	19	19.1	56.9	6.9	10.3	5.9	1.0
10	DORSET TOWER	18	17	6.7	54.2	15.0	11.7	12.5	-
11	NORMANSEL TO.	18	16	4.8	50.0	13.1	20.2	11.9	-
12	SALISBURY TO.	20	20	10.9	65.4	9.0	10.3	4.5	-
13	BARRY JACKSON	20	16	10.7	51.2	15.5	11.3	7.1	4.2

TABLE VIII-2:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR BEDROOM(S).

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	STRONGLY SATISFY	SATISFY	IN BETWEEN	DISSATISFY	STRONGLY DISSATISFY	%NO COMMENT
1.	LAPWORTH HO.	13	19	5.0	57.5	12.5	12.5	12.5	-
2.	DURHAM TOWER	20	18	10.0	60.0	2.0	22.0	6.0	-
3.	STOKESAY HO.	11	23	8.2	48.2	11.8	16.5	15.3	-
4.	NETLEY HOUSE	11	23	5.0	74.0	2.0	12.0	7.0	-
5.	WHEELDON HO.	11	17	13.1	69.7	4.1	9.0	4.1	-
6.	WESTON HOUSE	13	21	2.2	51.1	20.0	17.8	8.9	-
7.	WOBURN HOUSE	13	18	15.0	43.3	11.7	25.0	5.0	-
8.	BALDWIN HO.	15	20	5.0	60.0	13.7	6.3	15.0	-
9.	ESSINGTON HO.	15	19	18.2	55.3	8.2	4.7	12.9	0.6
10	DORSET TOWER	18	17	0.2	55.0	20.0	12.0	11.0	-
11	NORMANSEL TO.	18	16	3.6	57.9	7.9	23.6	7.1	-
12	SALISBURY TO.	20	20	12.3	66.2	4.6	13.1	3.8	-
13	BARRY JACKSON	20	16	10.7	52.9	17.9	10.0	5.0	3.5

TABLE VIII-3:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR KITCHEN.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	STRONGLY SATISFY	SATISFY	IN BETWEEN	DISSATISFY	STRONGLY DISSATISFY	%NO COMMENT
1.	LAPWORTH HO.	13	19	-	68.8	12.5	10.4	8.3	-
2.	DURHAM TOWER	20	18	20.0	65.0	1.7	10.0	3.3	-
3.	STOKESAY HO.	11	23	8.8	37.2	14.7	17.6	21.6	-
4.	NETLEY HOUSE	11	23	6.7	66.7	8.3	12.5	5.8	-
5.	WHEELDON HO.	11	17	12.6	67.8	8.1	8.6	2.9	-
6.	WESTON HOUSE	13	21	5.6	42.6	24.1	18.5	9.3	-
7.	WOBURN HOUSE	13	18	8.3	65.5	2.8	13.9	9.7	-
8.	BALDWIN HO.	15	20	5.2	70.9	3.1	13.5	7.3	-
9.	ESSINGTON HO.	15	19	26.5	63.2	2.0	4.9	3.4	-
10	DORSET TOWER	18	17	3.3	40.8	21.7	21.7	12.5	-
11	NORMANSEL TO.	18	16	6.5	61.3	6.5	17.9	7.7	-
12	SALISBURY TO.	20	20	7.7	63.5	7.1	16.0	5.8	-
13	BARRY JACKSON	20	16	8.3	61.3	12.5	8.3	6.0	3.6

TABLE VIII-4:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR BATHROOM AND W.C..

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	STRONGLY SATISFY	SATISFY	IN BETWEEN	DISSATISFY	STRONGLY DISSATISFY	%NO COMMENT
1.	LAPWORTH HO.	13	19	7.5	60.0	15.0	7.5	10.0	-
2.	DURHAM TOWER	20	18	10.0	60.0	2.0	18.0	10.0	-
3.	STOKESAY HO.	11	23	5.9	38.8	21.2	12.9	21.2	-
4.	NETLEY HOUSE	11	23	5.0	76.0	4.0	8.0	7.0	-
5.	WHEELDON HO.	11	17	15.2	60.0	6.2	11.7	6.9	-
6.	WESTON HOUSE	13	21	6.6	60.0	20.0	6.6	6.6	-
7.	WOBURN HOUSE	13	18	13.3	46.7	10.0	15.0	15.0	-
8.	BALDWIN HO.	15	20	6.2	65.0	6.2	18.8	3.8	-
9.	ESSINGTON HO.	15	19	22.4	62.9	5.3	6.5	2.9	-
10	DORSET TOWER	18	17	11.0	41.0	22.0	12.0	14.0	-
11	NORMANSEL TO.	18	16	6.4	53.6	7.9	25.0	7.1	-
12	SALISBURY TO.	20	20	4.6	70.8	9.2	13.1	2.3	-
13	BARRY JACKSON	20	16	9.3	60.0	15.0	6.4	5.7	3.6

TABLE VIII-5:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR GLADNESS IN LIVING IN THE DWELLING (QUEST. 254).

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	STRONGLY SATISFY	SATISFY	IN BETWEEN	DISSATISFY	STRONGLY DISSATISFY	%NO COMMENT
1.	LAPWORTH HO.	13	19	-	37.5	12.5	25.0	12.5	12.5
2.	DURHAM TOWER	20	18	10.0	10.0	20.0	10.0	50.0	-
3.	STOKESAY HO.	11	23	5.9	5.9	58.8	11.8	17.6	-
4.	NETLEY HOUSE	11	23	-	40.0	30.0	20.0	10.0	-
5.	WHEELDON HO.	11	17	27.6	62.1	6.9	3.4	-	-
6.	WESTON HOUSE	13	21	-	22.2	33.3	11.1	33.3	-
7.	WOBURN HOUSE	13	18	8.3	33.3	25.0	8.3	25.0	-
8.	BALDWIN HO.	15	20	6.3	12.5	50.0	25.0	6.3	-
9.	ESSINGTON HO.	15	19	20.6	38.2	20.6	8.8	5.9	5.9
10	DORSET TOWER	18	17	20.0	20.0	40.0	10.0	10.0	-
11	NORMANSEL TO.	18	16	-	14.3	14.3	32.1	39.3	-
12	SALISBURY TO.	20	20	3.8	46.2	30.8	15.4	3.8	-
13	BARRY JACKSON	20	16	3.6	17.9	53.6	14.3	7.1	3.6

TABLE VIII-6:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR THE DWELLING (IN GENERAL).

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	STRONGLY SATISFY	SATISFY	IN BETWEEN	DISSATISFY	STRONGLY DISSATISFY	%NO COMMENT
1.	LAPWORTH HO.	13	19	4.9	60.7	13.8	8.9	11.2	0.5
2.	DURHAM TOWER	20	18	11.8	56.8	3.9	16.8	10.7	-
3.	STOKESAY HO.	11	23	9.5	40.1	18.9	14.1	17.4	-
4.	NETLEY HOUSE	11	23	5.2	68.4	6.6	13.2	6.6	-
5.	WHEELDON HO.	11	17	12.7	67.6	7.9	7.8	4.1	-
6.	WESTON HOUSE	13	21	5.6	50.4	19.5	15.5	9.1	-
7.	WOBURN HOUSE	13	18	10.7	49.7	11.6	16.7	10.7	0.6
8.	BALDWIN HO.	15	20	6.7	57.4	12.5	14.3	9.2	-
9.	ESSINGTON HO.	15	19	21.0	58.0	6.7	7.5	5.8	1.1
10	DORSET TOWER	18	17	6.4	46.8	21.3	13.8	11.8	-
11	NORMANSEL TO.	18	16	5.0	49.2	10.5	22.7	12.6	-
12	SALISBURY TO.	20	20	7.7	65.1	9.5	13.7	4.0	-
13	BARRY JACKSON	20	16	8.5	53.4	17.5	10.3	6.6	3.7

TABLE VIII-7:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR FINISHES.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	STRONGLY SATISFY	SATISFY	IN BETWEEN	DISSATISFY	STRONGLY DISSATISFY	%NO COMMENT
1.	LAPWORTH HO.	13	19	-	48.6	25.0	8.3	18.1	-
2.	DURHAM TOWER	20	18	5.6	30.0	7.8	15.6	40.0	1.1
3.	STOKESAY HO.	11	23	3.9	24.2	20.2	25.5	24.8	1.3
4.	NETLEY HOUSE	11	23	1.7	67.8	11.1	13.3	6.1	-
5.	WHEELDON HO.	11	17	8.4	78.9	5.4	6.1	1.2	-
6.	WESTON HOUSE	13	21	-	54.3	22.2	13.6	8.6	1.2
7.	WOBURN HOUSE	13	18	-	28.7	17.6	23.1	30.6	-
8.	BALDWIN HO.	15	20	10.4	26.4	18.8	28.4	16.0	-
9.	ESSINGTON HO.	15	19	16.7	62.4	7.2	6.9	4.6	2.3
10	DORSET TOWER	18	17	4.4	45.0	26.7	15.6	8.3	-
11	NORMANSEL TO.	18	16	0.8	21.0	26.6	31.7	19.5	0.4
12	SALISBURY TO.	20	20	4.3	58.1	12.8	16.7	8.1	-
13	BARRY JACKSON	20	16	3.6	37.6	22.6	17.5	15.1	3.6

TABLE VIII-8:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR SERVICES.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	STRONGLY SATISFY	SATISFY	IN BETWEEN	DISSATISFY	STRONGLY DISSATISFY	%NO COMMENT
1.	LAPWORTH HO.	13	19	1.6	42.2	21.9	14.1	20.3	-
2.	DURHAM TOWER	20	18	10.0	53.3	6.7	15.6	13.3	1.1
3.	STOKESAY HO.	11	23	-	43.4	17.6	23.5	15.4	-
4.	NETLEY HOUSE	11	23	1.9	69.4	10.0	11.3	7.5	-
5.	WHEELDON HO.	11	17	6.1	67.1	4.6	13.0	9.2	-
6.	WESTON HOUSE	13	21	-	68.1	13.9	11.1	6.9	-
7.	WOBURN HOUSE	13	18	2.8	44.5	14.8	17.6	15.7	4.6
8.	BALDWIN HO.	15	20	12.5	46.1	10.2	18.0	12.5	0.8
9.	ESSINGTON HO.	15	19	15.9	63.2	3.7	7.7	8.5	1.1
10	DORSET TOWER	18	17	0.6	37.8	23.9	17.8	17.8	2.2
11	NORMANSEL TO.	18	16	5.2	36.1	21.8	21.4	15.1	0.4
12	SALISBURY TO.	20	20	1.5	68.3	10.1	11.1	9.1	-
13	BARRY JACKSON	20	16	2.4	44.8	26.9	20.2	6.7	-

TABLE VIII-9:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR ENVIRNMENT.

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	STRONGLY SATISFY	SATISFY	IN BETWEEN	DISSATISFY	STRONGLY DISSATISFY	%NO COMMENT
1.	LAPWORTH HO.	13	19	2.8	56.9	20.8	8.3	11.1	-
2.	DURHAM TOWER	20	18	8.9	38.9	10.0	20.0	21.0	1.1
3.	STOKESAY HO.	11	23	4.6	40.5	30.1	11.1	13.7	-
4.	NETLEY HOUSE	11	23	3.3	67.8	15.6	8.9	4.4	-
5.	WHEELDON HO.	11	17	13.0	57.1	10.1	14.6	5.4	-
6.	WESTON HOUSE	13	21	-	51.9	29.6	11.1	7.4	-
7.	WOBURN HOUSE	13	18	1.9	32.4	13.0	28.7	22.2	1.9
8.	BALDWIN HO.	15	20	5.6	49.3	15.3	18.1	10.4	1.4
9.	ESSINGTON HO.	15	19	14.7	61.4	12.1	4.2	2.9	4.6
10	DORSET TOWER	18	17	2.2	47.8	24.4	13.9	11.1	0.6
11	NORMANSEL TO.	18	16	2.8	41.7	17.1	24.2	13.9	0.4
12	SALISBURY TO.	20	20	3.4	44.9	28.6	17.9	5.1	-
13	BARRY JACkSON	20	16	2.0	40.9	29.4	21.4	6.3	-

TABLE VIII-10:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR THE BLOCK (IN GENERAL).

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	STRONGLY SATISFY	SATISFY	IN BETWEEN	DISSATISFY	STRONGLY DISSATISFY	%NO COMMENT
1.	LAPWORTH HO.	13	19	2.2	50.0	22.1	10.3	15.4	-
2.	DURHAM TOWER	20	18	8.9	38.0	8.0	19.1	25.1	0.9
3.	STOKESAY HO.	11	23	3.1	35.3	24.2	18.9	18.2	0.3
4.	NETLEY HOUSE	11	23	2.2	66.8	14.1	11.6	5.3	-
5.	WHEELDON HO.	11	17	10.8	68.6	6.8	9.8	4.0	-
6.	WESTON HOUSE	13	21	-	55.2	22.2	13.1	8.5	1.0
7.	WOBURN HOUSE	13	18	1.4	34.5	16.4	25.2	20.5	1.9
8.	BALDWIN HO.	15	20	8.1	39.5	15.6	22.1	14.0	0.7
9.	ESSINGTON HO.	15	19	16.6	61.2	8.8	6.7	4.2	2.5
10	DORSET TOWER	18	17	2.9	42.0	27.6	15.7	11.1	0.7
11	NORMANSEL TO.	18	16	2.5	32.7	21.4	26.7	16.4	0.3
12	SALISBURY TO.	20	20	3.2	56.7	17.6	16.0	6.6	-
13	BARRY JACKSON	20	16	2.3	37.6	28.5	21.5	9.1	1.0

TABLE VIII-11:

PERCENTAGES IN VARIOUS SATISFACTION CATEGORIES ON EACH BLOCK FOR SAFETY AND VANDALISM (QUESTS. 345+348).

No.	TOWER BLOCK NAMES	STOREYS No.	AGE (YEARS) 1988	STRONGLY SATISFY	SATISFY	IN BETWEEN	DISSATISFY	STRONGLY DISSATISFY	%NO COMMENT
1.	LAPWORTH HO.	13	19	12.5	31.3	25.0	12.5	18.8	-
2.	DURHAM TOWER	20	18	-	-	5.0	35.0	60.0	-
3.	STOKESAY HO.	11	23	2.9	11.8	17.6	23.5	44.1	-
4.	NETLEY HOUSE	11	23	2.5	27.5	27.5	32.5	10.0	-
5.	WHEELDON HO.	11	17	12.1	62.1	12.1	13.8	-	-
6.	WESTON HOUSE	13	21	-	16.7	11.1	38.9	33.3	-
7.	WOBURN HOUSE	13	18	-	-	8.3	58.3	33.3	-
8.	BALDWIN HO.	15	20	-	3.1	15.6	40.6	40.6	-
9.	ESSINGTON HO.	15	19	19.1	48.5	17.6	13.2	1.5	-
10	DORSET TOWER	18	17	5.0	15.0	37.5	27.5	15.0	-
11	NORMANSEL TO.	18	16	-	8.9	17.9	32.1	41.1	-
12	SALISBURY TO.	20	20	3.8	28.8	25.0	36.5	5.8	-
13	BARRY JACKSON	20	16	1.8	5.4	33.9	37.5	19.6	1.8

APPENDIX IX

CODEBOOK FOR THE SPSSx SYSTEM FILES SOAP88 USED IN THIS STUDY

The SPSSx system files **SOAP88** contains data from the 1987-88 social appraisal survey for the 13 chosen large panel blocks in Birmingham. Following is a list of the variables by cloumn number. On the same line the column number is coming first, and then the variable name. The more discriptive variable label is coming third, following by the codes used for the used scales.

Column Number	Variable Name	Variable Label	Codes
1.	**Biographical Data:**		
1 - 3	ID	Case Number	1,2,3,.....,C
4 - 5	BLOCK	Block Name	1,2,3,.....,13
6 - 7	FLOOR	Floor Number	G,1,2,.....,20
8 - 10	DWELLN	Dwelling Number	1,2,3,..,116
11	DWELLS	Size of Dwelling	1,2
12	SEX	Sex	1,2
13	AGE	Age	1,2,3,4
14	MARITAL	Marital Status	1,2,3
15-16	OCCUP	Occupation	1,2,3,4,0
17	PEOPN	How many people live at this address?	1,2,.....,P
18	CHILDN	Number of children living at this address	1,2,.....,C
19	ADULTN	Number of adults living at this address	1,2,......,D
20-21	YEARL	How long have you lived at this block	1,2,.....,Y
2.	**Dwelling Appraisal:**		
22-23	LROOM	Living Room (in General)	1,2,3,4,5
24	L211	There are no problems arranging and fitting furniture into the living room.	1,2,3,4,5
25	L212	The physical layout of the living room is good.	1,2,3,4,5

26	L213	The number of doors and windows in the living room aresatisfactory for daylighting and ventilation.	1,2,3,4,5
27	L214	The living room is large enough for day to day use.	1,2,3,4,5
28	L215	You are bothered by noise in the living room.	5,4,3,2,1
29	L216	The living room can be kept warm in winter.	1,2,3,4,5
30-31	BROOM	Bed Room(s) (in general)	1,2,3,4,5
32	B221	There are no problems arranging and fitting furniture into the bed room(s).	1,2,3,4,5
33	B222	The physical layout of the bed room(s) is good.	1,2,3,4,5
34	B223	There is sufficient sun light on the bed room(s).	1,2,3,4,5
35	B224	The sound insulation is good due to the bed room (s) position.	1,2,3,4,5
36	B225	There is enough storage space in the bed room(s).	1,2,3,4,5
37-38	KITCHEN	Kitchen (in general)	1,2,3,4,5
39	K231	There are no problems arranging and fitting furniture and appliances into the kitchen.	1,2,3,4,5
40	K232	There is enough storage space in the kitchen.	1,2,3,4,5
41	K233	The working arrangement in the kitchen is satisfactory.	1,2,3,4,5
42	K234	In the kitchen, there are adequate means to prevent cooking smells reaching other part of the dwelling.	1,2,3,4,5
43	K235	The kitchen is large enough.	1,2,3,4,5
44	K236	The kitchen units are satisfactory.	1,2,3,4,5
45-46	BATH	Bathroom & W.C. (in general)	1,2,3,4,5
47	BA241	The bathroom & W.C. are adequate.	1,2,3,4,5
48	BA242	There is adequate space in the bathroom & W.C..	1,2,3,4,5

49	BA243	The bathroom & W.C. fittings are satisfactory.	1,2,3,4,5
50	BA244	The position of the bathroom & W.C. allow(s) good ventilation.	1,2,3,4,5
51	BA245	There is adequate space to open the door and enter easily.	1,2,3,4,5
52-53	DWELL	The Dwelling (In general)	1,2,3,4,5
54	D251	The physical layout of the dwelling is good.	1,2,3,4,5
55	D252	The location of this dwelling within the building is good.	1,2,3,4,5
56	D253	There are no problems living in this particular dwelling.	1,2,3,4,5
57	D254	If I had to move away from this dwelling, I would be glad.	1,2,3,4,5
58	D255	There are no problems within the corridor.	1,2,3,4,5
59	D256	There are no places where children can play in the dwellings.	1,2,3,4,5
60	D257	In low-rise building, do you prefer the same layout of the dwelling?	1,2,3

3. Block Appraisal:

61-62	FINISH	Finishes (in general)	1,2,3,4,5
63	F311	The physical condition of the external cladding is in good repair.	1,2,3,4,5
64	F312	The plaster and wall coverings are in good condition.	1,2,3,4,5
65	F313	The doors and windows are generally in good condition.	1,2,3,4,5
66	F314	The internal fixtures are generally good.	1,2,3,4,5
67	F315	There are no problems with the condition of refuse chute-room.	1,2,3,4,5
68	F316	There are no problems with the operation of the doors and windows.	1,2,3,4,5
69	F317	Front and rear main doors are in good repair.	1,2,3,4,5

70	F318	The communal areas are generally in good condition.	1,2,3,4,5
71	F319	The security system in the block is properly used.	1,2,3,4,5
72-73	SERVIC	Services (in general)	1,2,3,4,5
74	S321	The system of heating used is adequate.	1,2,3,4,5
75	S322	The water supply is generally adequate.	1,2,3,4,5
76	S323	There are no problems with the plumbing and drainage systems.	1,2,3,4,5
77	S324	The number of switches and power points are satisfactory.	1,2,3,4,5
78	S325	The lift(s) does work very well.	1,2,3,4,5
79	S326	The form of ventilation used is efficient.	1,2,3,4,5
80	S327	Noise is not a problem living in this particular dwelling.	1,2,3,4,5
1 (new line)	S328	There is no problem with the gas supply (if any).	0,1,2,3,4,5
2	S329	In general the services supplied in this block are adequate.	1,2,3,4,5
3-4	ENVIR	Environment (in general)	1,2,3,4,5
5	E331	Public services on the estate are adequate.	1,2,3,4,5
6	E332	The physical layout of the area around the block is good.	1,2,3,4,5
7	E333	The green areas around the block are in good condition.	1,2,3,4,5
8	E334	Parking facilities on the estate are good.	1,2,3,4,5
9	E335	The footpath to and from the block are in good condition.	1,2,3,4,5
10	E336	There are enough facilities for children to play on this estate.	1,2,3,4,5
11	E337	There are no health problems associated with living here.	1,2,3,4,5
12	E338	There are adequate health and shopping	

		facilities around the block.	1,2,3,4,5
13	E339	Children playing around here make a problem.	5,4,3,2,1
14-16	BLOCK	The Block (in general)	1,2,3,4,5
17	BL341	The physical layout of the block is generally poor.	5,4,3,2,1
18	BL342	Facilities provided within the block are good.	1,2,3,4,5
19	BL343	The block is well situated within this area of the estate.	1,2,3,4,5
20	BL344	There is no privacy living in this block.	5,4,3,2,1
21	BL345	It feels unsafe walking about different parts of the building at night.	1,2,3,4,5
22	BL346	In general, the estate is satisfactory to live in.	1,2,3,4,5
23	BL347	In general, the neighbours are friendly people.	1,2,3,4,5
24	BL348	There is no vandalism on this block.	1,2,3,4,5

4. General Information:

25	ACCOM	What sort of accommodation would you ideally like to live in?	0,1,2,3,4
26-27	HEIGHT	What do you think the maximum storey height of blocks should be?	1,2,.....,9,0
28-29	FLOLIK	Which floor would you most like to live on?	1,2,.....,9,0
30	HEATS	Do you use the centeral heating system of the building?	1,2,3
31	HEATUSE	If No, What sort of heating system do you use?	1,2,3,4,0

Appendix X

RONAN POINT

X.1 Background

Ronan Point was a 23-storey large panel tower block (Larsen Neilsen system) built by Taylor Woodrow-Anglian (TWA) Limited. In May 1968, there was a gas explosion on the eighteenth floor which blew out concrete panels which formed part of the load-bearing flank wall of one dwelling. This caused progressive collapse of the south east corner of the block.

This disaster had implications for all large panel system built tower blocks. The advice to the local authorities was to appraise all their blocks over 6 storeys in height which were built of large pre-cast concrete panels to form load-bearing walls or floors of both in order to consider whether they were susceptible to progressive collapse[49]. New standards were set. Remedial action was required in all existing stock. The elements had to be strong enough to withstand a freak accident such as a gas explosion or a fire or alternatively there had to be some alternative means of support if one particular element was removed. Extra bolted angle connections were required at the H2 joints. These standards were also applied to new designs. The report of the inquiry warned in specific terms about the dangers of storing explosive substances such as liquied petroleum gas (LPG)[48].

Ronan Point was rebuilt using an insitu concrete frame to support the corner. Even though the physical problems seemed to have been solved, Newham Borough Council were left with this infamous block in which nobody wanted to live. In 1984, inspectors from the council found small gaps at the junctions between non-load bearing cladding panels of the facade and the floor panels in Ronan Point. It was decided to appraise the block. Several reports were commissioned to investigate the structure, its current condition with reference to structural stability, including resistance to wind loading, gas explosion and the effects of fire[51,52,53].

The BRE submitted a report "The structure of Ronan Point and other Taylor Woodrow-Anglian buildings" [53], which summarised the consultants' reports on Ronan Point. Conclusions were made relating to the structural adequacy and the remedial measures necessary to maintain it in a satisfactory structural condition. The implications and needs for structural appraisal and remedial measures on other TWA buildings were discussed.

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Figure IX-1 Idealised original H2 Joint (Pre-Strengthening).

The main structural problems centred around the main H2 joint. This is the standard floor/cladding panel detail. Figure IX-1 shows the original idealised detail of

H2 joint, and Figure IX-2 shows the modifications which were made to strengthen the block as a result of the 1968 explosion and also some of defects recorded with the "as built" detail. From a structural point of view the higher the block then the greater the stresses induced in joints at the ground floor. The pre-cast panels at Ronan Point were placed on top of an insitu concrete ground floor podium, though there were no dwellings on the ground floor.

Figure IX-2 Revised, as built, H2 Joint (Post Strengthening).

In its report, the BRE concluded that Ronan Point had coped well with substantial normal loads and an abnormal load arising from a fire test since its reconstruction following the partial collapse in 1968. No structural distress was observed. However, there were possible remedial measures required; such as the reconstruction or strengthening of the H2 joints at highly stressed locations, more comprehensive strengthening of the building by constructing an additional load-bearing system at the flank walls up to the eight floor or the removal of eight storeys from the top of the building.

X.2 The Final Demise:

The final fate of Ronan Point was sealed as a result of a BRE fire test in 1984. It was found that there were two major points for concern. One was that the panels bowed with the heat, so that fire and smoke stopping would have to be improved. The second problem was that the flank wall joint could rotate under the effects of extreme heat. In the worst case, it was suggested that this could lead to enough displacement of the joint to promote partial collapse.

The poor workmanship came to light when Newham conducted a radar survey of a north flank wall in 1984. The survey was conducted from a 9 meter cradle suspended outside the building with the joints subjected to a radar test. The survey gave an indication of the percentage of voids in a joint, however it did not show how well the mortar was compacted. The results were calibrated with 100 core samples. The London Borough of Newham was faced with several alternatives. The cost of structural strengthening was assessed at £28,600 for each of the 110 dwellings. If additional works were to be carried out, such as modernisation, then the costs rose to £52,000 per dwelling. Faced of these astronomical costs Newham decided to demolish Ronan Point.

However, demolition proved to be another expensive option. It was not possible to blow up the block due to nearby low-rise housing and the fear that the block' asymmetric strength (from the reconstructed south east corner in 1968) could cause the demolition to be unpredictable. The presence of asbestos in the outer skin of the building precluded the "ball and Chain" approach to demolition. Instead the borough had to opt for a dismantling operation. In December 1985, tenders were invited for the demolition of the block.

The bid selected was £578,000. It proposed that floor and wall slab joints were to be broken and that the individual precast panels were then to lowered to the ground by crane. The contractor (Griffiths-McGee demolition company Ltd.) that won the contract built a "birdcage scaffold" which surrounded the building. Fans protruded from the building at the 7th and 14th storeys to catch any stray debris. At all times the top six storeys were covered with polythene sheeting to prevent dust spreading to nearby houses.

The contractor aimed to dismantle at least one floor per week. Initially the in-situ concrete infill between the floor joints and the cladding panel was broken out with pneumatic breakers, as shown in plate X-1. The demolition process is carefully described in an October 86 article of Building "Infernal Tower", which goes into great detail as to how the tower crane was set up on the old base used by Taylor Woodrow (TWA) company during the original construction. Each panel had to be propped while it was broken out and then it was lifted down.

The crane had sufficient capacity to allow it to rock the panel if it was found to be particularly stubborn. Fine rubble was removed in skips rather than using chutes, as it proved quieter. For the same reason electrically driven, rather than diesel driven, compressors were used. Water was used to dampen down the dust so as not to cause nuisance to those living nearby.

There was also the tender requirement to remove some of the panels so that the BRE could conduct tests as part of its assessment work on the large panel system built buildings. Newham engineer, throughout the contract, kept detailed records of

Plate X-1 The joints breaker used electrically driven compressor.

what they found in the mortar packings. These are being compared with the radar survey so that reasonable assessment can be made of the state of the mortar packings in Newham's other TWA tower blocks (which have already been surveyed by radar).

Now that Ronan Point has gone, it is worth noting that the London Borough of Newham will still be paying for it and for its demolition for the next several years.