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DEVELOPMENT OF THE CONSTRUCTION INDUSTRY IN EUROPE: 1/ UNITED KINGDOM EXPERIENCE

by

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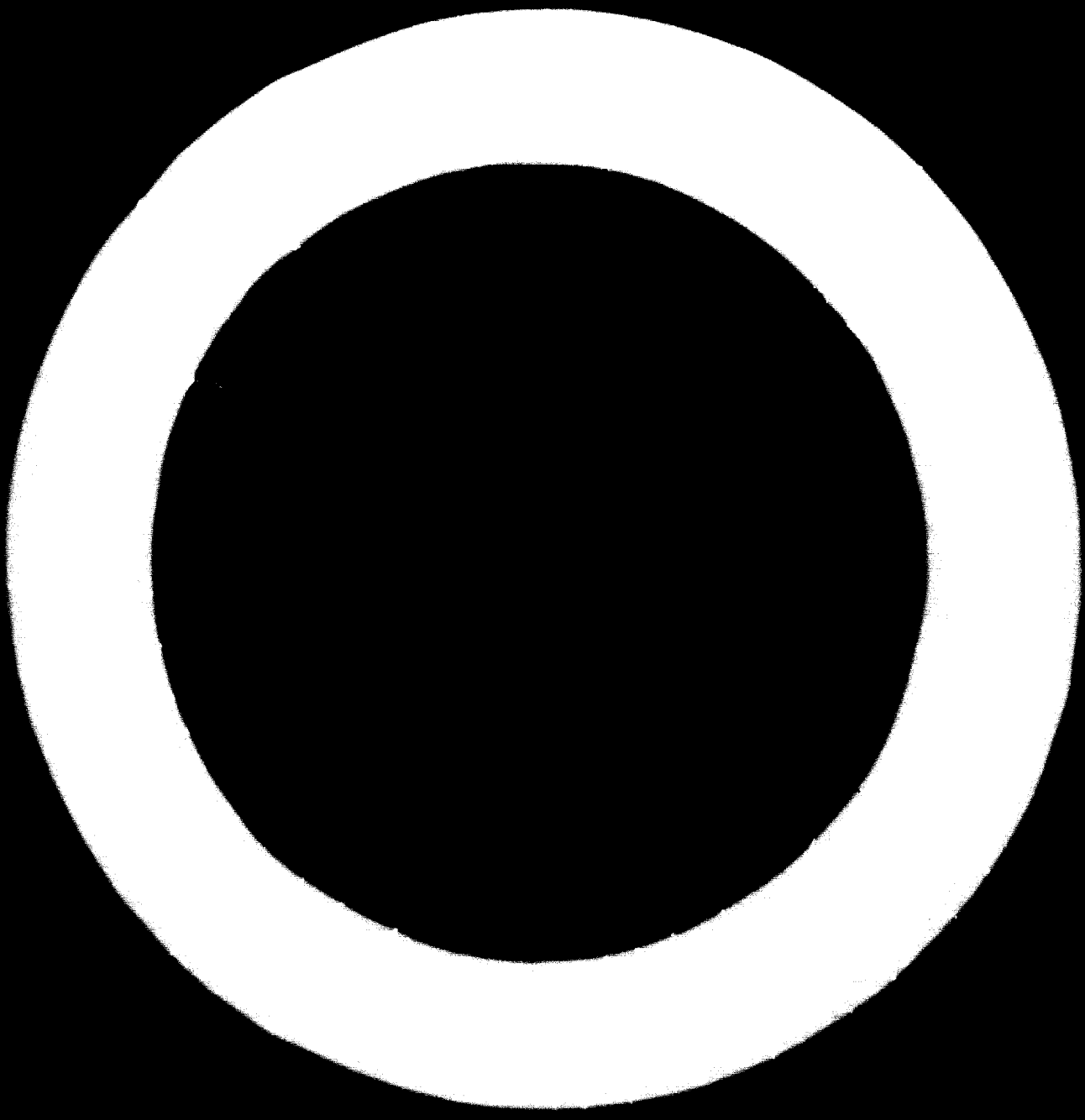

SUMMARY

The paper traces the development of the construction industry in the United Kingdom from its beginnings in the industrial revolution, demonstrating the gradual separation of the roles of the professions, the contractors and the supplies of building materials. The growth of the private housing market led to new types of financial institutions that were intended to assist people who lacked sufficient funds to buy their houses outright, such as Building Societies, charitable trusts and Co-operative Societies. The way in which the speculative private housing market became a specialised "consumer-oriented" division of the industry is described.

The remainder of the industry caters for a "bespoke" demand, and the influence of government and local government bodies is emphasised, with implications of fluctuating spending according to national economic conditions. The development and growing specialisation of the professions is traced, and the implications of a watertight division of responsibilities between architect, engineer and contractor is discussed.

The second section evaluates the present situation in the industry and analyses trends. The structure and emphasis of employment policy in the industry is contrasted with the needs of developing countries. Various attempts at improving productivity include system building, and the advantages and disadvantages of this approach are discussed. The important trends to modular co-ordination is emphasised together with implications of a higher required standard of accuracy in construction.

The trend to mechanisation and the growth of the plant hire industry is limited by the structure of the industry, and the repairs and maintenance sector and the smaller building contracts are not normally susceptible to economy through mechanisation. However, the shortage of suitable labour has led to an increasing use of construction plant.

A further important trend is the recognition of the vital role of training, marked by the setting up in 1964 of the Construction Industry Training Board. The C.I.T.B. was given power to levy funds from construction firms in order to make available technical training for their managers, operatives and personnel as well as grant-aiding attendance at relevant courses provided by other institutions.

The third section gives statistical data on the input and output of the sector, including the contribution to overall employment and the gross national product. The trends of output are given for housing, industrial, commercial and public building works for the years 1969 to 1972, together with projections for 1973 to 1975.

In addition to new works, approximately £1,000 is spent each year on repairs and maintenance, and there is also a

growing trend to 'do-it-yourself', in which individual householders obtain timber, wallpaper, paint and other materials and carry out the smaller jobs around their homes.

A table gives the numbers and labour resources of U.K. construction firms, and emphasises that the 4 per cent of firms which employ 60 or more operatives provide almost two-thirds of the total employment in the industry. A further table analyses numbers of construction firms and operatives by trades.

1. THE DEVELOPMENT OF THE U.K. CONSTRUCTION INDUSTRY

1.1 The growth of building and civil engineering as an industry in the U.K. can be traced back to the industrial revolution with its implications on construction demand resulting from the application of steam power, the growth of factories and the increase of the scale of industry and of the demand for transport improvements. The movement of population from the rural to the urban areas of the country produced a substantially increased demand for housing and, later, for community facilities. Before the nineteenth century, communications were generally poor and the market for both goods and labour was so local that there was little call for building to be organised on an industrial basis. The coming of the railways in the 1830's and 1840's, besides opening considerable scope for contractors in themselves, also encouraged a much freer movement of men and materials and boosted industrial demand for construction expertise.

1.2 The larger scale of the works to be undertaken led inevitably to greater specialisation. In the case of the railway companies, the company as client commissioned an engineer to design and supervise the construction of the permanent way, together with the associated earthworks, buildings, bridges and tunnels. The engineer was responsible for advising the client on suitable contractors for the work, which was usually let in sections. Much of this work would be regarded as testing even by today's standards. One example is the 3 km. long box tunnel on the Great Western Railway which was constructed during the years 1836-1841, involving 190,000 cubic metres of excavation, all of which was hauled up the shafts in buckets by means of horse gins at the surface. One contractor alone, George Burge of Horne Day, undertook to build over three-quarters of the length and the remaining section was to be driven through solid Bath stone by two local men. A further

contract for the supply of bricks to line the tunnel required a total of 30,000,000 bricks over a three-year period.

1.3 These developments in the civil engineering side of the construction industry were paralleled by the growth of general building contractors, who were prepared to contract for the construction of a complete building with the client, and so obviate the need to make separate contracts with each individual trade. The "master builder" then employed a team of specialist craftsmen - masons, bricklayers, carpenters, etc. - to carry out the work. Although the traditional crafts and trades fought fiercely to maintain their previous monopoly of building work, the old fragmented form of organisation could not compete with the newer firms of master builders as demand for factories, commercial and industrial premises grew. Housing demand also grew and in turn led to a demand for new civic and public buildings in the conurbations. The overall growth of the industry in the latter part of the nineteenth century is illustrated by the increase in the total number of employees from 390,000 in 1851 to 953,000 in 1901. The proportion of the population employed in the industry also increased; in 1851 it had been 1 in 46 persons but by 1901 it had grown to 1 in 34. Although it is sometimes suggested that the building industry is by its nature conservative and highly resistant to change, this great expansion in employment and output was accompanied by developments in the organisation of the industry to suit the developing and changing markets for its products. Furthermore the increasing engineering skills and knowledge was reflected in changes in the products themselves, including the methods of construction as well as the production and availability of building materials and components.

1.4 As the market for construction developed, it became clear that the demand and the potential clients were in several distinct

categories. However, in only one area could the building industry deal direct with individual consumers rather than through businesses, civic authorities or government ministries. This was of course the market for private housing, and it provided a profitable opportunity for the estate developers. Since only a limited number of people had sufficient wealth to be able to buy their houses outright, new types of financial institution grew up to meet the need. One particularly important group were the non-profit making Building Societies, which offered a reasonable rate of interest to investors and lent their funds to individuals on the security of mortgages on their houses. Co-operative Societies also supplied funds to members and even undertook some development directly, building houses both to let and for owner-occupation. Local authorities, many of which were re-organised and given greater powers in the late nineteenth century, also began to act as developers in their own right, catering for the needs of the poorer groups in their areas who required houses to rent. It is interesting to note that all these institutions set up to provide sources of finance, were all non-profit making, and in fact a number of charitable trusts were also started to organise the erection, and retain the ownership, of dwellings for poorer families. However, these institutions did not see the quality of the surrounding environment as an important concern, with the result that many of the suburban developments of this time presented an unplanned and unattractive appearance. This led to the formation in 1899 of the Garden City Association, with the objective of introducing the idea of comprehensive urban planning, which was followed by the foundation of Letchworth Garden City, Hampstead Garden Suburb and the Liverpool Garden Suburb.

1.5 The ready supply of finance, together with the growing demand for lower and middle income housing, created conditions in which

the speculative estate developer flourished. This feature of the housing market did not in general apply to other sectors of the building industry, such as industrial, commercial, public and institutional buildings, where the client employed an architect or designer and required that the structure be custom-made to his individual requirements. Thus the private housing estate developers became the only main section of the industry that is effectively consumer-oriented in that its product must be designed by the constructor to sell on the open market, as distinct from the rest of the construction industry, which tenders and builds according to design and specifications supplied by the architect or engineer to the specific requirements of the client.

This 'bespoke' feature of demand is not an unmixed blessing for the contracting industry, since the absence of the need for a general 'sales' function is balanced by other constraints on resource planning. While firms operating in other product areas of a market economy face the problem of selling to a wholesale or retail market, once a market share is established the demand can be forecast with reasonable accuracy, and resources of finance, men, materials and plant can be mobilised to meet it. However the contractor has to tender for work in the knowledge that only 1 in 10 or 1 in 20 of his bids are likely to be succesful. Thus he is forced to tender for 10 or 20 times as much work as he feels able to cope with, with the risk that at any given time he could be faced with a workload far greater or far less than the capacity of his organisation. To these dangers must be added the common 'feast and famine' nature of construction demand, much of which emanates from government ministries or local authorities, where spending can fluctuate considerably according to national economic conditions.

1.7 While the process side of the industry in the nineteenth century was featured by the growth of the general contractor and the master builder, similar formal developments were occurring in the professions. It is true that there were many notable individual British architects in the late seventeenth and eighteenth centuries, but it was not until 1834 that a group of well-known architects of the time agreed to form the Institution of British Architects, with the aim of regulating entry into the profession and maintaining professional standards. This body later became the Royal Institute of British Architects receiving its charter in 1837.

1.8 The civil engineering profession had already formed a 'Society of persons studying the profession of a Civil Engineer' in 1818 known as the Institution of Civil Engineers. Its membership at that time was limited to young men, not less than 20 and not more than 35, and the first President, Henry Robinson Palmer, was only 22 years of age. However, two years later, Telford agreed to accept the Presidency of the Institution, and it gradually gained acceptance among established engineers. In 1824 the object of the Institution was rewritten as follows:

> "For the general advancement of Mechanical Science, and, more particularly, for promoting the acquisition of that species of knowledge which constitutes the profession of a Civil Engineer; being the art of directing the Great Sources of power in Nature for the use and convenience of man, as a means of production and of traffic in States, both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and locks, and in the construction of ports, harbours, moles, breakwaters and lighthouses and in the art of navigation by artificial power for the purpose of commerce; and in the construction of machinery; and in the drainage of cities and towns".

1.9 One contrast between the approach of the architectural and engineering professions was in the field of rules for professional conduct. The RIBA took the view that it was improper for any of its members to have a pecuniary interest in a building firm, whereas there is no similar constriant on a chartered civil engineer. Thus professional engineers can, during their career, gain experience of work in both the contracting and consulting sides of the industry, although if they run consulting firms and are members of the Association of Consulting Engineers, they are not permitted to have any financial involvement with a contracting firm.

1.10 Training in the professions in the first part of the nineteenth century was usually by indenture agreement or pupillage, sometimes supplemented by foreign travel and by attendance at occasional lectures. However, in 1840 a Chair in the Arts of Construction was established at King's College, London, and in 1841 a Chair in Architecture was established at University College, London. A few years later, in 1847 the Architectural Association was founded with the object of promoting the study of architecture and providing a school for training. However, the RIBA did not introduce a formal system of tests and examinations until 1882. This was voluntary at first, but the supplementary charter in 1887 gave powers to develop the system of examinations and arrange, as far as practicable, a systematic course of education for all those entering the profession.[1] Similar steps were taken by the Institution of Civil Engineers, but examinations for corporate membership were not introduced until 1897.

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1 - Modern English Architecture. C. Marriott.

1.11 One other major professional division that developed in the latter half of the nineteenth century was that of the quantity surveyor. Originally it was the custom for the contractors tendering for a proposed scheme to be provided with a set of drawings and a specification, and each contractor drew up his own bill of quantities so that he could calculate the unit prices at which he would be prepared to carry out the work. Later, builders realised that this resulted in a costly waste of effort when 10 or more builders employed individual estimators and only one could offset the cost against the contract when it was eventually awarded, and began to employ one estimato jointly to provide a bill of quantities. In time it became the custom for the quantity surveyor on such work to be appointed and paid by the client. This relieved the builders of the expense and, at the same time, provided the building owner with a surveyor to represent him in any later negotiations. [2] The Royal Institution of Chartered Surveyors was founded in 1868 and included quantity surveyors, and when in 1904 a separate Quantity Surveyors' Association was founded, the RICS establishe a special 'Quantity Surveyors Committee'.

1.12 Thus, what Bowley describes as "the system" grew up of a separation of the three phases which lead to the completion of a building:

1. Working out the overall design in accordance with the client's requirements for accommodation and amenities.

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2 - The British Building Industry. Marian Bowley.

2. Calculating the structural design to ensure that the building is durable, resists anticipated loadings and climatic conditions and that the services work.

3. Actually producing the building and making it ready for occupation.

In broad terms the first phase is the speciality of the architect, the second of the structural, civil or services engineer and the third the province of the building contractor who is only involved after the design phases are complete and tender documents prepared. Thus the contractor has no opportunity to apply his experience at the design stage and suggest ways in which the objective of the client could be accomplished more economically. On the watertight division of responsibilities, Bowley comments:

> "In sum, the separation of design responsibilities from building responsibility enabled builders to neglect their own education in design, or avoid the employment of designers, and the architect to neglect his own education in building practice and the employment of building technicians. Equally the development of the system of independent quantity surveyors enabled designers to neglect proper study of estimating and avoid the employment of estimators".

13 Another feature of this 'system' was the absence of competition in design. Although this does have some advantages for the client in that in a competitive situation, design contracts might be won by less scrupulous operators who employed unqualified staffs or skimped their work, it does have the effect of insulating the designer from the effects of uneconomic design or inaccurate costings. As the twentieth century progressed,

and building contractors [illegible] resourceful, they began to resent the generally inferior position assigned to them by this 'system'. In some cases contracting firms were run by fully qualified civil engineers, and employed a well-qualified staff of estimators, buyers, engineers, surveyors, and draughtsmen. Thus at least one large building firm, Bovis Limited, developed the idea of a package deal in which the contractor was able to advise on and influence the choice of design in order to ensure that an economic choice of methods and materials would be possible.

ANALYSIS OF THE PRESENT SITUATION AND TRENDS

1 One of the crucial factors which determine the general organisation of any building industry is the availability of suitably-qualified and experienced labour. In the United Kingdom, as in many other countries in Western Europe, this has proved a major constraint on the growth potential of the industry and has led employers to investigate methods of labour saving as well as introducing bonus incentive schemes to encourage higher productivity. This is of course in marked contrast to the usual problem in developing countries, where the building and civil engineering industries have a vital role to play in employment creation through the introduction of intermediate technologies.

2 In an industrialised country, such as the United Kingdom, many men prfer the more congenial employment opportunities offered by factory work. In fact the then Ministry of Labour outlined the special characteristics of working conditions in the construction industry as follows:- [1]

(a) Geographical mobility
(b) Uncertainty of future employment
(c) Interruptions caused by bad weather
(d) Unsatisfactory welfare conditions
(e) Sensitivity to economic and seasonal fluctuations.

These factors have continued to apply, and the industry finds it difficult to expand its resources rapidly to cope with increased demand. The most recent enquiry into the use of labour in building and civil engineering was that of the Phelps-Brown Committee [2] in 1968, which made the following comments relating to productivity:

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1 - Ministry of Labour Manpower Study no. 5 H.M.S.O.

2 - Report of the Committee of Enquiry under Professor E. H. Phelps-Brown into certain matters concerning labour in building and civil engineering, July 1968, Cmnd. 3714 H.M.S.O.

1. There is a substantial loss of productivity by the breaking up of teams who are used to working together; but it is generally possible to slow down the rate of labour turnover.

2. The Economic Development Committee for Building and Civil Engineering should extend their forecasts of the demand on the industry to three years ahead, to encourage firms to plan their manpower requirements; government should make firmer commitments ahead; and there should be regional economic forecasts for the industry.

3. Within the framework of more positive employment policies (see 5 below), companies themselves can maintain more stable labour forces by:

   (a) improved ways of transferring operatives from site to site.

   (b) building up permanent labour forces in given areas and seeing more work in these areas.

4. The number of operatives working under labour-only subcontracts may be between 165,000 and 200,000. The practice is more prevalent in house-building, in the South and the Midlands. Although labour-only subcontracting is open to abuses, were it abolished the industry would suffer. A standard form of subcontract should be developed.

5. Technical advances in the industry have not been matched by improvements in the handling of personnel relationships. The report made a number of recommendations on the subjects of training, recruitment, wages policy, welfare facilities and fringe benefits. It also recommended greater discussion and consultation between employers and unions on employment policies.

4 The above comments highlight some of the problems faced by building employers at a time of full employment. In order to maximise the productivity of their employees, their site organisation must be improved at the same time as the working conditions, wages and fringe benefits. When labour was a flexible resource and could be hired and disengaged at will; increased costs due to delays in the delivery of components and materials or the provision of working drawings and details were limited to those of holding idle equipment on the job, together with overhead costs such as salaries of foremen and supervisors. But in the circumstances which have prevailed since the second world war, building and civil engineering contractors have been forced to seek methods by which the involvement of labour in their site operations could be minimised.

One such method which has been tried with varying degrees of success is system building. This was started on a considerable scale in the late 1950's and can be defined as the putting together of a series of factory-made components according to some form of proprietary system. There are a number of types of building that are required in such quantities as to make them susceptible to the potential economics of system building, particularly houses, schools and factories. However there were a great many different systems put forward by the various firms which were attracted into this market, with the result that each was only able to secure a relatively small proportion of it. Thus progress has not lived up to the initial expectations, and the amount of capital which is tied up in plant and machinery has led a number of firms to leave this branch of the industry. It seems probable that system building in the U.K. will continue to be of most importance in local authority housing and schools and private factory and warehousing development, where the final product is of a standard type and the market is comparatively large. For all but a few well-established and nationally approved systems, it has been a continuous struggle for survival and many firms have been operating well below capacity.

2.6 Progress of high rise system building in the U.K. was further delayed by the repercussions of the partial collapse of the system-built council-owned tower block known as Ronan Point in Canning Town, South London in May 1968 after a gas explosion in one of the flats. [1] This collapse led to a great deal of unfavourable publicity, and structural safety checks were carried out on tower blocks throughout the country. The Ministry advised 51 local authorities to carry out an urgent check on 2,500 dwellings, and in some cases tenants were evacuated. Ronan Point itself was of load bearing panel construction and the tribunal found that there was a lack of continuity at the joints, which could lead to progressive collapse if any part of the load bearing walls was to fail.

2.7 Thus although a number of established 'heavy' concrete systems, such as Bison Wall Frame and Jespeson have continued to refine their manufacturing and assembly techniques and have gained increasing acceptance, it is in the use of new materials or established materials in different ways that has been one of the most interesting trends in recent years. Prefabrication of components has grown particularly, and a notable trend has been towards the supply of manufactured frames and joinery items, which have replaced site-fabricated joinery for most types of buildings. The use of prefabricated steel and aluminium frames is also becoming more common. The use of wet plaster is also declining, since it is often replaced with plasterboard and plaster panels. Although bricks retain a major place as a walling material particularly in private housing development, due to their aesthetic appeal, precast concrete blocks can be used as replacements in some cases. The plastics industry has successfully penetrated the building materials market, particularly in flooring materials, pipes and rainwater goods.

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1. Report on the enquiry into the collapse of flats at Ronan Point, Canning Town. Ministry of Housing and local Government. 1968. HMSO.

8 One of the most valuable trends has been towards modular co-ordination in the construction industry. Following work over a period of years by the Modular Society, in 1968 the British Standards Institution published BS 4330: Recommendations for the co-ordination of Dimensions in Building: Controlling Dimensions. This led to full discussions between representatives of the government, the building materials industry and the construction industry, and the recent change from imperial to metric measures yielded an opportunity for the introduction of preferred dimensions on a wide scale. A Component Co-ordination Group was set up at the Department of the Environment (then the Ministry of Building and Public Works.), and BSI panels were set up to recommend suitable component sizes.

9 Modular co-ordination is already bringing about useful savings in labour and materials on the site since it allows materials and components to be fitted together without waste and with a minimum of cutting and packing to adjust levels and distances. The reduction of the range of sizes is of assistance to manufacturers and builders' merchants since it increases the production runs of each item and reduces the range of stock that must be carried. However, there are difficulties. Firstly, there is the cost of large scale re-tooling. Secondly, there are difficulties resulting from the lack of dimensional accuracy in traditional building components and in building construction generally. Many traditional building materials produced from clay, concrete and plaster are subject to a high degree of shrinkage and warping during their production process and a high degree of dimensional accuracy cannot be guaranteed. There is also a 'tradition' of dimensional inaccuracy in the building trade, and it is not uncommon to find tolerance ranges of as much as 8 or 10cm. in room dimensions in small houses. These tolerances could be easily accomodated by traditional building techniques, but are far too great where components have been

fabricated to given dimensions. However, there are clear advantages to be gained from increased use of modular co-ordination and these are beginning to be realised.

2.10 Another approach to the problem of low productivity is through mechanisation of the construction process. It is certainly true that the building and civil engineering industries in the U.K. lag behind manufacturing industry in the amount of mechanical power that they make available to their operatives. However it must be remembered that the builders' site is increasingly a place for assembly rather than the manufacture of components, and it is generally easier to effect economies through mechanisation in manufacture rather than assembly operations. Since the location of construction work by definitio changes as one job follows another, it is carried out in the open air and the nature of the work itself is so variable, one great factor in the choice of construction plant is versatility. Purchase of plant is an expensive item for the contractor and it must be continuously employed throughout its life if expected economics are to be achieved. Since the general building or civil engineering contractor tenders for a wide variety of work, and is rarely able to forecast the nature of his workload more than six or nine months ahead, this continuity is difficult to achieve.

2.11 These difficulties have spurred the growth of the plant hire industry, which makes plant of all kinds available for hourly, daily or weekly hire. This allows the contractor to limit his usage of individual items of plant to the periods when he actuall needs them on site, with the added advantage of avoiding a capital outlay which increases the proportion of his total assets which are available to finance work in progress. These advantage are obvious in the case of major items of plant such as mobile cranes, crawler tractors and excavators, but plant hire firms now offer compressors, dumpers, concrete mixers and scaffolding for hire, thus enabling a contractor to 'top up' his resources, if his own plant is occupied elsewhere. In addition, many

contracting firms have set up their own plant hire subsidiaries, which supply their own needs at an advantageous rate but are also available for hire to other firms.

2.12 When considering the potential for higher plant utilisation, it is necessary to bear in mind that the possibilities of using mechanical plant are limited in general to repetitive work or the lifting and positioning of heavy items. In the U.K. about one third of the turnover of the industry consists of repairs and maintenance, where the opportunities for mechanisation are limited to the use of powered hand tools in most cases. The possibilities for using mechanical plant are greatest in civil engineering work, such as roads, bridges and dams and in multi-storey building construction. But the proportion of work which is readily susceptible to mechanisation is strictly limited in the average small building contract, as can be seen by examining the work content by trades for a traditional small house. [1]

Fig. 1 Trade Breakdown for a Traditional House.

Trade	% of man-hours	
	Craftsmen	Labourers
Excavator, concreter, drainlayer etc.	1.7	15.5
Scaffolder	3.1	-
Bricklayer	21.0	15.0
Carpenter and Joiner	14.3	-
Electrician	2.3	0.3
Gas - fitter	1.0	0.1
Plasterer	7.0	3.0
Plumber	5.0	0.3
Glazier	0.3	-
Painter	6.6	-
Mastic floorlayer	1.7	-
Tiler and Slater	1.0	0.8
Total for trade	65.0	35.0

1 - National Building Studies, Special Reports. Nos. 18 and 21 H.M.S.O.

2.13 It will be noted that about two-thirds of the work content is attributable to skilled craftsmen, mainly bricklayers, carpenter plasterers and painters. Little of this work can be successfull mechanised, and the scope for mechanisation is generally limited to the "fetching and carrying" of the labourers. Usually the labourers' time is equally split into excavation and groundworks handling and moving material, and general jobs such as cleaning up and preparation. Thus it appears that only about 10% of the man hours associated with housing construction as traditionally approached in the U.K. is likely to be susceptible to further mechanisation, and that builders will have to look elsewhere for major improvements in productivity.

2.14 The relationship between the cost of the plant in comparison with the cost of labour which it is intended to replace is obviously different for a country such as the U.K. from the relationship in a developing country with different employment and economic characteristics. In the absence of other criteria, the higher the earnings of the labour suitable for carrying out the operation manually in relation to the labour manufacturing and maintaining the machines, the more worthwhile the substitution of the machine for manual methods is likely to be. Other criteria of particular importance in developing countries: namely the need to install labour-intensive intermediate technologies to encourage employment opportunities together with the need to conserve foreign exchange, have less force in the U.K. In the U.K. wages in manufacturing industry and construction are comparable, so there is not the compelling need to mechanise that is felt in, for example, the U.S.A. where building labour is at a premium.

2.15 The greatest inroads of the machinery manufacturers and distributors in the U.K. are probably in the field of earth movement, i.e. digging, excavating, levelling and moving soil. This work has a high component of physical force rather than skill, and it

relation to its hourly cost the earth-moving machine can carry out many times the work of the man it replaces. Thus small excavators are often used on comparatively small jobs such as digging holes for foundations and drainage trenches.

2.16 Another major area of mechanisation is in the mixing of materials. Mechanical mixing of concrete is use for all but the smallest jobs, and the choice usually lies between mixing on the site and the direct purchase of ready-mixed concrete from a specialist. The market penetration of ready-mixed concrete has grown very considerably over the last 10 - 15 years and plants have been set up in most of the populous areas of the country. Whether or not ready-mixed concrete is cheaper than mixing on the site depends on the availability of sand and aggregates locally, on the location of the ready-mixed plant in relation to the job, on the amount of concrete required, and on where and how the concrete is to be placed. Generally, it tends to pay to use ready-mixed concrete when it is required intermittently over a contract period, providing the concrete is required in batches at least equal to a full load of the delivery truck. The greatest economies tend to be realised in concrete road construction and heavy foundations where the delivery truck can often place the concrete direct into position without double handling. A further recent development is the use of mobile concrete pumps, which allow the contractor to place the concrete more efficiently. As well as the advantages of convenience, the improved reliability of the mix and the reduction of wastage of materials make the use of ready-mixed plaster and mortar an increasingly attractive proposition.

2.17 The third major category is materials handling plant. The main mechanical aids for the vertical handling of materials are hoists, elevators and cranes. Horizontal handling plant ranges from the mechanised barrow to dumpers, conveyor belts and monorail or railway systems. With the growth of multi-storey

building in the last twenty years, the tower crane has substantially grown in importance, as it greatly eased the task of handling large building units and sections of framework. Since it is expensive compared with most items of contractors' plant, its introduction led to a tendency to re-plan the method of site organisation around it so that full utilisation could be achieved. This led to a far greater degree of pre-planning of work, which may well have had a greater beneficial effect than the direct savings associated with the improved handling facilities.

2.18 There are of course a variety of other types of plant which are utilised in building and civil engineering construction, such as compressor tools for roadbreaking and drilling and powered hand tools. In addition there is the large category of specialised road making plant, such as surfacing machines, spreaders and rollers which are mainly operated by specialist companies. There is also an increased use of patent formwork and scaffolding systems. However, it seems unlikely that the increased us of mechanical plant can offer any easy solution to the problem of increasing productivity.

2.19 A further important trend which has become clear over the past decade is a general appreciation of the importance of training at all levels of the construction industry. Although the professional institutions associated with the industry, such as the Institution of Civil Engineers and the A.R.I.B.A., have traditions of high entry qualifications and require evidence of academic knowledge of the discipline and professional experience worthwhile post-qualification courses were a rarity and many other in the industry had no access to systematic courses of training. These problems were not confined to the construction industry and the Construction Industries Training Board was set up in 1964 by the U.K. Government, as one of a series of Training Boards for a number of industries. The Board was given power to levy funds from construction firms and was required to

spend this money in making available technical training for their managers, operatives and personnel as well as grant-aiding attendance at relevant courses provided by other institutions.

.20 This was a significant move for the U.K. construction industry and the firms within it. Employment was often on a casual basis, and even the largest firms relied heavily on self-employed 'labour only sub-contractors' who were paid a fixed price for whichever task they contracted to undertake. This multiplicity of small sub-contracting firms, often consisting of a single gang who moved from job to job, were unable to provide any kind of thoughtful training programmes.

.21 Although the smallest building firms, consisting of only one or two partners, are now exempt from the CITB levy, much of the total levy is raised from what the CITB defines as 'small firms', that is firms with less than 60 employees. The CITB came to realise that a small firm's real needs are not just for training of its operatives, but must include training in management skills for the contractor himself.

.22 As a result of this consideration, the CITB set up a 'small firms training programme'; as part of this scheme it has mounted a considerable number of courses for small builders, using a series of teaching 'modules' not dissimilar from the 'kits' that the IT Building team has prepared for use in African countries. The courses are usually of three days duration and they are held at a local technical college or other accommodation hired for the purpose. Any contractor in the area may apply to attend a course, but usually the number of those accepted on any one course is limited to fifteen. Each module covers a specific topic, and the small contractor can attend a series of three day courses by choosing from a total of 20 different modules.

2.23 The idea has been put forward that there should be a specific 'development path' for each contracting firm. The principal could decide, with assistance from the Training Consultant, his own development path for three to five years ahead. In making this decision, he should be encouraged to recognise his own management shortcomings and the organisational shortcomings of his firm so that he can select a training process stretching over several years to improve his business performance in a systematic way.

2.24 The first step on this development path would be a series of 'management appreciation' courses for large numbers of builders. Then, approximately ten per cent of these would attend a further series of courses that would be prepared to serve the individual contractor's development needs. It has been suggested, however, that there is a real need to supplement the training courses with 'on site' and 'in office' consultancy, to ensure that the principles and techniques introduced in the courses are fully implemented and applied in practice. Implementation is often the most difficult stage for the small builder, where the proprietor is fully committed with day-to-day administration and has little time to design new systems, explain them to his staff and carry them into effect.

2.25 It may be that this new emphasis on training is the most relevant of recent trends in the U.K. industry to construction problems in the developing countries. Admittedly, the overall economic emphasis is very different; in the U.K. a lack of general manpower resources and a tendency for men to leave the industry to seek more attractive work elsewhere, and in the developing countries a high degree of unemployment and underemployment. But most developing countries would benefit from a similar direction of attention towards their manpower resources, since they are rarely exploiting the potential for labour-intensive methods to the full.

STATISTICAL DATA ON INPUT AND OUTPUT OF THE SECTOR

The U.K. construction industry, including both building and civil engineering works, contributes about 7 per cent of the gross national product, and investment in new buildings and works represents between 9 and 10 per cent of the gross national product compared with figures of 10 to 15 per cent for other EEC countries and the U.S.A. U.K. investment in new buildings and works accounts for just over half of total investment, which is rather lower than the 60 per cent figure common in other major developed countries.

Table 1 below gives output figures in terms of new work for the sector, in £ millions at 1963 prices, together with forecast figures prepared by the NEDO Joint Forecasting Committee for the Building and Civil Engineering Industries.

TABLE 1 VALUE OF OUTPUT OF NEW CONSTRUCTION WORK
In £ millions at 1963 prices:

	ACTUAL				FORECAST		
	1969	1970	1971	1972	1973	1974	1975
New Housing - Public	575	501	454	413	420	405	385
" " - Private	453	516	469	536	565	545	555
Other Public Work	976	1002	1033	1000	1040	1085	1105
Private Industrial	429	421	395	350	375	395	395
Private Commercial	355	354	500	395	405	425	425
TOTALS	2778	2694	2751	2694	2805	2855	2865

These figures combine the output of contracting firms and direct labour organisations, and demonstrate the decline in overall output of the sector from £2,778 millions in 1969 to £2,694 millions in 1972. However, this follows growth from £1,806

millions in 1959 and a trend rate of growth of rather over 4.5 per cent over the decade.

3.3 One major problem for the industry is the tendency for demand to fluctuate from year to year according to the general economic situation. Table 2 gives a comparison of the percentage changes in value of output for new construction work:-

TABLE 2 YEAR ON YEAR PERCENTAGE CHANGES IN VALUE OF OUTPUT OF NEW CONSTRUCTION WORK

	ACTUAL				FORECAST		
	1969	1970	1971	1972	1973	1974	1975
New Housing - Public	- 6.5	-12.9	- 9.4	- 9.0	+ 1.5	- 5.5	- 5.0
New Housing - Private	-16.0	- 8.2	+12.7	+24.5	+ 5.5	- 5.5	+ 2.0
Other Public Work	+ 0.1	+ 2.7	+ 5.1	+ 5.2	+ 4.0	+ 4.0	+ 1.5
Private Industrial	+ 9.7	+ 0.5	- 6.2	-11.4	+ 7.0	+ 5.0	NC
Private Commercial	+ 0.5	- 0.5	+13.0	- 1.2	+ 5.0	+ 4.0	NC
TOTAL NEW WORK	- 3.0	- 3.0	+ 2.1	- 2.1	+ 4.0	+ 2.0	+ 0.5

NC - No change

Since most contracting firms specialise in certain types of work, and operate only in certain parts of country, the 'feast and famine' nature of their market is considerably greater than suggested by the national figures above.

3.4 In addition to the expenditure on new works, approximately £1,000 millions is spent each year on repairs and maintenance; Many of the smaller jobbing building forms specialise in this work, and the remainder is carried out by maintenance departments of the industrial and commercial firms and direct labour

departments of government ministries, nationalised industries and local authorities. There is also a notable trend to 'do-it-yourself' in which individual householders obtain timber, wallpaper, paint and other materials and carry out the smaller jobs around their homes to avoid the heavy labour charges imposed by commercial firms.

5 The construction industry accounts for some 6 to 7 per cent of total U.K. employees, and 50 per cent of these work for large firms employing 600 or more people. However, there is a very great range of size of firms in the U.K. industry and a further 50 per cent are with firms employing less than 35 persons. There is also a substantial number of men who are 'self employed' and sell their services to contractors on a piece-work basis individually or as members of a small gang specialising in pipe-laying, groundwork, brickwork or carpentry.

6 There are just over 80,000 separate firms engaged in the industry, but many of these are relatively very small in terms of capacity, as indicated in Table 3:-

TABLE 3 NUMBERS AND LABOUR RESOURCES OF CONSTRUCTION FIRMS

NUMBER OF OPERATIVES EMPLOYED	NUMBER OF FIRMS	PERCENTAGE OF FIRMS IN GROUP	NUMBER OF OPERATIVES	PERCENTAGE OF LABOUR FORCE
				Working Principals
Nil - 1	20,303	25.1	(18,923)	7.1
2 - 7	36,959	45.7	17,078	6.6
8 - 13	9,284	11.5	70,620	22.7
14 - 59	11,187	13.8	241,576	10.4
60 - 114	1,633	2.0	110,938	13.6
115 - 299	980	1.2	144,083	39.6
300 and over	523	-.7	420,896	
	80,869	100.0	1,064,191	100.0

Although the smaller firms predominate in numbers, most of the operatives in the industry are employed by the larger firms

with 60 or more employees are set out more fully in Table 3a below:-

TABLE 3a NUMBERS AND LABOUR RESOURCES OF CONSTRUCTION FIRMS

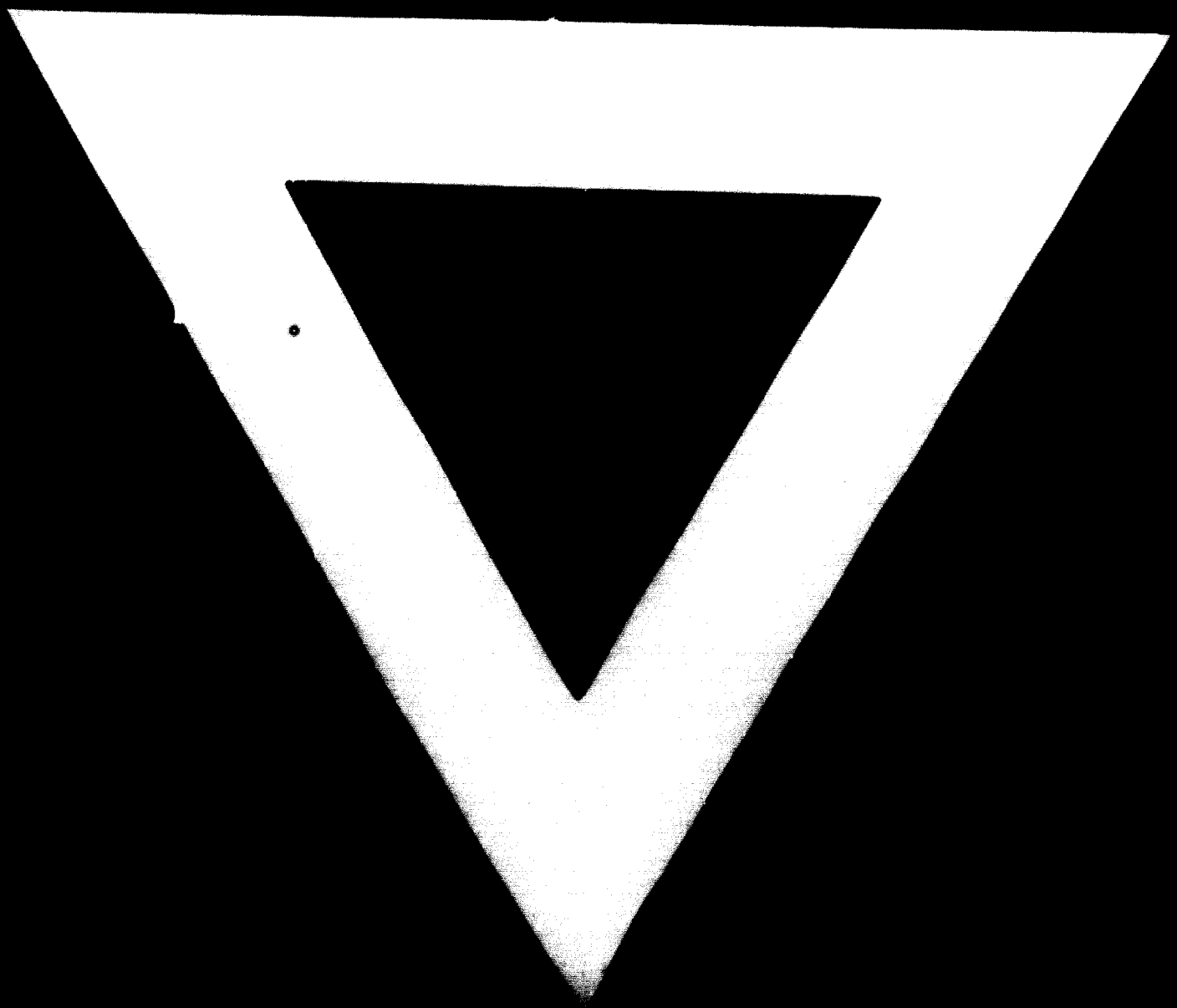
	PERCENTAGE OF FIRMS	PERCENTAGE OF OPERATIVES
Firms employing Nil/1 person	25%	Nil
" " 2/59 "	71%	37%
" " 60 and over	4%	63%

3.7 Table 4 gives a breakdown of the total number of firms and operatives into the eighteen principal trades:

TABLE 4 CONSTRUCTION FIRMS AND OPERATIVES ANALYSED BY TRADE

DESCRIPTION OF FIRM BY PREDOMINANT TRADE	NUMBER OF FIRMS	NUMBER OF OPERATIVES	AVERAGE NUMBER OF OPERATIVES
General Builders	34,732	284,866	8
Building and Civil Engineers	3,022	350,785	117
Civil Engineers	1,473	89,749	61
Plumbers	8,417	35,595	4
Carpenters and Joiners	5,624	24,331	4
Painters	13,907	56,911	4
Roofers	1,508	14,902	10
Plasterers	3,141	20,985	7
Glaziers	301	3,905	13
Demolition Contractors	290	3,365	12
Scaffolding Specialists	81	6,674	82
Reinforced Concrete Specialists	216	11,857	55
Heating and Ventilating	1,315	36,226	27
Electrical Contractors	4,454	59,367	13
Asphalte Contractors	250	14,122	57
Plant Hirers	1,006	18,221	18
Flooring Contractors	716	8,466	12
Constructional Engineers	436	25,854	59
	80,869	1,064,191	13

Thus 'general builders' are the most numerous, but 'building and civil engineering contractors', with an average number of employees of 117, provides most employment.



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