TECHNOLOGICAL RESEARCH IN RESIDENTIAL REHABILITATION

IN THE UNITED STATES --

AN OVERVIEW

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ABSTRACT

The document briefly traces Federal activities in residential rehabilitation from the early 1930's to the present time. Most attention is given to projects since 1963 and especially to the technological experimentation associated with those projects. The introduction touches on the reasons for Federal concern with neighborhood rehabilitation, the nature of the problems involved in massive programs, and the extent to which solutions have been found or need yet to be investigated. The main section of the document contains brief descriptions of the more technologically significant projects. Special attention is given to the rapid rehabilitation project completed in 48 hours on East 5th Street in New York City. A bibliography also is included.

AUTHORS FOREWORD

This paper was prepared at the request of the Office of Policy Development & Research of the U.S. Department of Housing and Urban Development (HUD). It is intended to be used as background for the development of a research program in Residential Rehabilitation by the Division of Building Technology and Safety.

Few formal reports dealing with rehabilitation technology have been published on the projects treated in this report and HUD files and records on them are meager. Thus, this paper suffers for this lack of background material as well as by having been prepared under a very tight time constraint. A substantial part of the paper derives from recollections of the author, who was personally associated with many of the projects.

When available, information on the number of units involved in a project has been included as has data on processing and construction times, mortgage amounts, and other pertinent "vital statistics" types of information. A special effort has been made to include available cost information to permit some comparisons with new construction costs or with different methods of rehabilitation. Caution must be used in comparing costs of different projects because each has some unique characteristics affecting its costs. Likewise, caution is required in making comparisons between rehabilitation and new construction, since the quality of living offered by different living units may vary widely. In the absence of a standard by which to measure the quality of a living unit, such as a "figure of merit", objective comparisons are difficult.

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INTRODUCTION and SUMMARY

Before 1960, Federal housing programs were not concerned with rehabilitation to any significant degree. However, in the 1930's, the Rural Resettlement Administration (RRA), the Home Owner's Loan Corporation (HOLC), and the Federal Housing Administration (FHA), were involved with rehabilitation to some extent. The RRA program endeavored to upgrade the homes of very low-income rural families to provide decent, safe and sanitary structures. The HOLC and FHA programs largely entailed the repair and modernization of homes of middle-income families in urban areas. The total effect of all of these programs was minimal.

The Housing Act of 1954 with its urban renewal programs included neighborhood rehabilitation, but the point was largely lost to slum clearance activities. The Housing Act of 1961 included very strong redirection toward rehabilitation rather than clearance. Thus, it came to be recognized more widely as an additional tool of urban renewal. More serious attention was given to the subject and the problems associated with carrying out such programs were studied. Others, also, in time were struck by the value of neighborhood rehabilitation as a means to recreate the city (1).

Within FHA and the Urban Renewal Administration (URA), initial concerns quite properly were directed towards the problems of financing neighborhood rehabilitation projects -- FHA processing, construction standards, code enforcement, mortgage terms, etc. -- problems which have come to be lumped under the

term "institutional constraints" (2). Consequently, the early experimental rehabilitation projects, in fact nearly all of them to the date of this paper, have had as a principal or at least a major component -- finding better methods for overcoming the institutional barriers.

Later in the 1960's, due in part to changing times and to the undertaking of rehabilitation projects in occupied structures in the hard-core cities, people problems surfaced. Citizen resistance to change, demands and needs for involvement, tenant relocation difficulties, etc., represent "sociological constraints" to massive rehabilitation projects. Beginning with the New York City projects, these people problems increasingly became the focus of attention and finding how best to handle them became a principal experimental goal. (By far the most comprehensive presentation of the sociological aspects of rehabilitation, and their relationships to the institutional and technological concerns, are contained in the Gabel report (3) covering the New York City Rehabilitation Experiments which began in 1955)

The success HUD's most recent rehabilitation project, Project Rehab, has had in large-scale rehabilitation in many cities throughout the country indicates that the solutions to institutional and sociological barriers are fairly well in hand. This is not to say that more knowledge in these areas is unnecessary or that improvements are not desirable. But the problems are now manageable.

Experimentation to understand and overcome costly "technological barriers" to massive rehabilitation has been almost entirely lacking. With the exception of the East 5th Street rapid rehabilitation project in New York City, no significant technological research has been included in any of the projects to date. Unlike new construction, which in the past decade has advanced to higher levels of industrialization, rehabilitation construction is still a hand-crafted highly labor-intensive and painfully slow process. Essentially no

progress toward industrialization has been made. A great deal of the work requires the time-consuming fitting of new materials and fixtures into existing construction (4). Work methods typically, are as old as the buildings upon which the work is being done.

Massive gutting of interiors is practiced in Project Rehab because of the inability to selectively choose those items which need to be replaced and those which can be repaired. Inability to measure old, distorted building interiors with the required degree of accuracy precludes the use of many manufactured components. Cost estimating and scheduling is antiquated. Rehabilitation construction remains an art rather than a technology.

Thus, buildings which could be rehabilitated economically are passed by in the belief that they are not suitable candidates for rehabilitation. Since most rehabilitation for low- and moderate-income families is financed through some form of subsidy, each dollar wasted in construction costs because of failure to use available technology, represents a direct dollar addition on the nation's tax burden.

The principal experimental projects from 1961 to the date of this paper are briefly described on the following pages. Major attention has been given to those projects which involved some technology experimentation. In its time, each of these projects gathered its critics, for each one involved some element of failure. Being experimental, none fully met its announced goals. Each one, however, also enjoyed successes and viewed from the present, can be seen as having contributed important knowledge and experience from which subsequent projects benefited. This paper endeavors to de-emphasize the controversies. It concentrates on the knowledge and experience which resulted from these experimental projects.

DESCRIPTION of SELECTED PROJECTS

Baltimore, Md. -- Harlem Park Area

In 1961, through a joint undertaking of the Federal Housing Administration, the Urban Renewal Administration and the Baltimore Urban Renewal and Housing Agency, an experiment in residential rehabilitation was carried out in the Harlem Park Urban Renewal Area of Baltimore, Maryland (5). It involved some 32 blocks (150 acres) and contained over 4000 single-family, brick, row houses close to the center of the City. Following World War II, the area developed into an overcrowded slum with the structures converted into multiple dwellings and rooming houses.

Harlem Park was chosen for this joint effort because: (a) it was quite typical of the type of situation then being encountered in the rehabilitation efforts and contained most of the problems; (b) the local housing authorities were cooperative, had adequate staffs and seemed committed to the task; (c) local financial institutions had exhibited an interest in rehabilitation and (d) the area was close enough to Washington to allow top FHA and URA staff to participate and learn from the experiment.

This experiment was not directly concerned with the physical rehabilitation of the area but rather with setting up the internal FHA procedures needed. It was directed mainly at obtaining a fuller understanding of the institutional constraints to successful residential rehabilitation and to the developing of effective methods for dealing with them. During the fall of 1961 and winter of 1962, Washington officials of the Agencies, worked with the Baltimore offices and were successful in setting up realistic and workable procedures for processing rehabilitation projects.

The experiences showed that those Federal agencies involved could work together effectively and jointly with local agencies to accomplish

rehabilitation on a substantial scale. The importance of securing the interest and cooperation of private lenders and private contractors as well as the absentee owners was shown. Highlighted also, was the importance of local community involvement in relocating displaced families and dealing effectively with hardship cases. No other element of the sociological problems seems to have been encountered.

Technological research was limited to finding a way to reconcile the application of FHA's standards for new construction to rehabilitation construction and to devising a suitable cost estimating system. Performance standards as set out in the "objectives" of FHA's Minimum Property Standards proved lacking in the necessary degree of specificity for rehabilitation work. Parties who had "agreed" on reconstruction standards for Harlem Park found, upon close examination of detailed items, that they had not "communicated". Thus, when the project got underway, it was necessary to go back and, in great detail, repeat the process of arriving at agreed upon standards. New minimum standards for rehabilitation (6) were developed by FHA following the Harlem Park experience. They proved helpful in later undertakings. However, the problem of determining the proper level of physical rehabilitation with some degree of uniformity and confidence still exists.

New York City

Beginning in 1963, a number of rehabilitation projects including technological experimentation were undertaken in New York City. Several of these (particularly, West 15th Street, West 114th Street and East 5th Street) involved technological experimentation directed mainly at finding ways to rehabilitate older multiple dwellings without undue physical or economic displacement of the tenants. One such effort (West 15th Street) attempted extensive rehabilitation without moving tenants from the building. Another (West 114th Street) attempted to minimize dislocation by undertaking phased

rehabilitation of an entire block (both sides of a block-long street) so as to move tenants only within the block, as sections were completed. By far the most ambitious technological experiment of all HUD rehabilitation activities was the East 5th Street project. Dubbed "instant rehabilitation", it was a real-time experiment-test directed towards learning to what extent very rapid rehabilitation (48 hours) could be made economically feasible and used to minimize disruption of tenant's lives (7). It endeavored to attain a level of industrialization of rehabilitation significantly higher than had theretofore been attempted.

Cooperating with HUD, the U.S. Gypsum Company undertook technological experimentation in the rehabilitation of a number of buildings (notably, East 102nd Street and East 103rd Street) in Manhattan. Perceived as a marketing strategy and a real-life "laboratory", this program was a testing ground for some of the Company's products prior to offering them to the public. An understanding of the problems of rehabilitation to aid in new product development for the rehabilitation market also was sought (8).

West 15th Street

The first building completed under this experimental program in New York City (134 West 15th Street) was a five-story walk-up containing 20 apartments -- four per floor(9). With five unoccupied apartments when the work began, tenants were moved temporarily within the building to clear a vertical quadrant (a five-story tier of apartments) for rehabilitation work. As each quadrant was finished the original tenants were moved in and another quadrant cleared, enabling the contractor to work on one tier of apartments at a time.

New bathrooms and kitchens were installed and much of the old plaster was removed and replaced. Efforts to eliminate the annoyance to tenants during the operation were unsuccessful, especially while removing old, broken and cracked plaster. However, the tenants, though annoyed during the construction process, were pleased with the rehabilitated apartments. The work required

nine months -- a typical time for rehabilitation work -- and cost $161,000, including $50,000 to acquire the old building.

Because of the annoyance caused tenants during construction, City authorities found it necessary to maintain a very active tenant relations program. The concept of avoiding tenant dislocation by rehabilitating an occupied structure was therefore abandoned.

West 114th Street

A second experiment was conducted on West 114th Street in another effort to find a way to rehabilitate with the least disruption to the lives of those occupying the buildings. All of the buildings on both sides of the street in the block between 7th and 8th Avenues were acquired by a non-profit foundation. There were a total of 450 apartments which housed approximately 1600 people. Two buildings were vacant and enough vacant apartments in other buildings on the block permitted a third building to be vacated. The first construction phase involved these three vacant buildings. Subsequent phased construction made it unnecessary for any family to move from the block. It was hoped that in this way dislocation could be held to a minimum.

Aside from this goal, the 114th Street project was perhaps the most ambitious of all insofar as social goals were concerned (3). In addition to "brick and mortar" rehabilitation, the project included a major program of rehabilitation of the families living there. Extensive tenant services and counseling were provided and useful experience was gained in handling the human relations aspects of a rehabilitation project.

The phased construction plan for minimizing disruption of tenant lives was moderately successful. However, many tenant problems developed in the course of the work which indicated that other methods to accomplish this objective needed to be found. Also, it was thought unrealistic to expect that such large groups of contiguous buildings could be acquired and worked on at

one time in a regular and continuing program.

Technological experimentation on 114th Street was mainly devoted to speeding up the work, maintaining the plan of phased construction so as to minimize tenant disruption, and directed at "targets of opportunity" for lowering cost or improving the quality of the finished product. For instance, gypsum wallboard (dry wall) was successfully used for the first time in New York City and was considered a major breakthrough (10). An unsuccessful system for leveling the old floors by using a plastic foam was tested. Generally considered as the most innovative "hardware" item was the installation of trash chutes in all buildings. Tenants could dump trash and garbage into the chute at openings on each floor which emptied into an enclosure in the basement where it was collected into containers for city curbside pickup. Through the cooperation of the National Pest Control Association, special construction techniques were used to reduce the rat population. Training classes also were conducted by the Association to educate tenants in rodent and roach control measures.

East 5th Street

Developing from the conclusion on West 114th Street that phased construction was not a wholly satisfactory answer to the tenant relocation problem, a system for very rapid rehabilitation was developed and tested on East 5th Street. Of all the rehabilitation activities of HUD to the date of this paper, only this project represents an extensive and serious technological experiment. It began in 1966 and was completed in 1967 at a research cost of about $1.2 million. In addition, an FHA insured mortgage of about $0.5 million was involved. Additional funds for evaluation and report writing were expended.

Three buildings (Nos. 633, 635 and 637) originally containing about 60 apartments were involved in the experiment. Two buildings (Nos. 635 and 637)

were vacant and the third housed 20 families when the work began. When completed, the project contained 47 apartments.

The major objectives of this research and development project were to:

1. Test the use of special components and methods for the rehabilitation of all the living units in an entire building in 48 hours, thus minimizing disruption of tenant's lives.

2. Obtain cost data and experience so as to better determine the economies of very rapid rehabilitation and to better estimate the optimum time period for such reconstruction.

3. Test the feasibility of applying new building technology and advanced technological concepts to rehabilitation of an old structure.

4. Ascertain what level of industrialization of rehabilitation construction could be attained.

The experimental plan provided for using the two vacant buildings as laboratories where the final techniques could be developed. The third occupied building was then used for the real-time test of the techniques developed. The goal was to complete rehabilitation of the occupied building during a 48-hour period while the tenants were housed in a hotel and their furniture and other possessions stored in lockers on a nearby vacant lot.

The firm of Conrad Engineers of California was employed to undertake the experiment and the entire U.S. building industry (construction contractors, home builders, materials manufacturers, engineers, architects, associations, other Federal agencies, etc.) was asked to participate and assist. Several hundred assisted, and approximately 100 made contributions which were worthy of testing, and in many cases use, in the final test-demonstration. One company designed and manufactured an aluminum window which was adjustable to fit a variety of openings. Another produced a folding, knock-down closet designed for quick installation. The most spectacular development was a service core unit containing a kitchen and bathroom with all electrical wiring, plumbing

and heating for each apartment. These were built on a pier on the East River, trucked to the site and lowered by crane through vertical shafts cut through the buildings. They were the first module core units to be installed as a part of permanent housing in the U.S. (11).

The most significant technological achievement of the project was the very extensive and complete Critical Path Scheduling developed for the 48-hour effort on the final building. Beginning with demolition of the interior and ending with final clean-up of the interior, each task was identified, the time for starting and finishing specified, work crews were scheduled around the clock and the number of men and type of trade required was set forth in great detail for each floor. Detailed instructions with sketches for performing each task were prepared including the number and type of tools required. The flow of materials and components into and out of the building was studied and carefully set forth. Materials packaging and storage locations were predetermined, including instructions for unpackaging. Provisions for inspecting and testing for quality control were made. During the 48-hour period, monitoring of critical features was made possible by closed circuit TV and radio communication was used by the Conrad supervisory staff and the HUD inspection team. Radio communication also was used to direct the crane operator in the placement of the service core units. The contractor (Conrad Engineers) submitted a detailed report on this scheduling (12).

The above techniques developed in the vacant buildings were applied to the occupied building during the final demonstration-test beginning on April 10, and ending on April 12, 1967. The 11 families still occupying the building were moved to a nearby hotel, selective interior demolition was performed, new walls of vinyl-covered gypsum board and new finish floors of particleboard were installed, new drop ceilings placed, new windows and doors installed, mechanical service cores including new baths and kitchens lowered

by crane through the roof, new electrical wiring, the heating system renovated, and a complete interior painting and clean-up before the tenants moved back at the end of 48 hours. A building containing 20, one-bedroom apartments was converted into 10, one-bedroom and 5, three-bedroom apartments. Exterior construction and some interior work in the basement and public areas was done before and after the 48-hour period.

The most critical report (13), written on the project, viewed it as having been brilliantly successful in demonstrating that an advanced technological approach can greatly reduce the time for physical rehabilitation of a multiple dwelling. The project proved that a systems approach to rehabilitation was possible and that the process could be accelerated (3).

However, many difficulties were encountered. Much time was taken to determine that the old buildings (built in the 1890's) were structurally sound. Over the years, the buildings had settled and neither were the floors level nor were the walls plumb. Thus, measuring for the core units, premanufactured windows, precut wall material, etc., was extremely difficult. The scheduling of the work and the flow of men and materials throughout the confined spaces were troublesome.

These technical difficulties proved relatively simple compared to the institutional barriers encountered. Trade Union relations and work rules were most troublesome and costly. For one thing, a six month's strike of the plumbers union resulted in virtual shut-down of the job during that period. A carpenter crew assembled and trained to lower the service core units was required to "take on" untrained iron workers a few hours before the final effort. The core units had to be built in Manhattan rather than at a more economical location in Queens, because two Plumbers Locals were involved and the Manhattan Local would not install units built by the Queens Local.

New York City red tape, particularly in the Building Department, was perhaps the single most troublesome and costly barrier. Even the personal intervention on several occasions of the Mayor did little more than solve the problem of the moment. Original agreements between the City and HUD regarding offsite testing of the plumbing work were disregarded and many man-hours required to arrive at new agreements. In normal construction, city inspections are scheduled in advance (often several days), but this was not possible during the 48-hour period. Numerous permits (approximately 32) were required by numerous city offices, each one requiring a fee and sometimes a performance bond. It was impossible to be sure all required permits had been secured and maintained current. An archaic building code (since superseded) required lead closet bends for water closets, allowed only one system for installing a drop ceiling, etc. The appeal procedures for obtaining waivers or variances were cumbersome and in no way intended to provide for rapid construction.

Clearly, the major criticism of the project was its cost (13). The fact that it was experimental and a first-time, test-demonstration; that it was confronted with Trade Union and New York City barriers; that it was essentially closed down during a six-month plumber's strike, etc., contributed to the excessive cost. Following the 48-hour test, HUD staff, assisted by two private analysts, prepared a very careful analysis of the costs incurred on the one building (7). Total construction costs for this one building were $366,504 or $24,400 per living unit. The costs incurred due to the "one-time" nature of the job and due to its having been scheduled for a specific period of time were estimated and deducted from these totals. Thus it was estimated that those costs properly attributable to the actual 48-hour construction were $281,748 or $18,800 per living unit. A study of the scheduling, with particular attention to the overtime costs associated with the 48-hour effort, indicated that an optimum time period for the rapid rehabilitation method would be about two weeks.

An estimate of the cost to complete another building, using a two-week construction period, was approximately $12,000 per living unit; for an additional 10 buildings, approximately $10,500; and for an additional 100 buildings, approximately $10,000. The study concluded that if certain administrative, policy, building code and work practice constraints were removed, an additional 100 buildings could be rehabilitated for $6,600 per living unit.

A study for new multifamily public housing costs in Manhattan was also made by HUD (14) to aid in judging the worth of rehabilitation versus new housing. Based on the same dollars (1967), total development costs for new public housing in Manhattan had ranged from $19,000 to $30,000 per living unit. The study concluded that these costs could be reduced by about 11% if certain constraints were removed from new construction. The constraints referred to have a lower cost effect on new construction than on rapid rehabilitation because administrative practices, work rules and the building code system are geared to the slower methods of construction, and in large measure, also to new construction practices. No effort was made to compare the quality of living in the new versus the rehabilitated construction.

U.S. Gypsum Company Projects

Beginning in 1964, the U.S. Gypsum Company acquired first one, and later five buildings on 102nd Street in Manhattan between 1st and 2nd Avenues (15). The five, six-story buildings contained 177 apartments with 294 occupants. The first building to be rehabilitated (307-9 East 102nd Street) was acquired for $30,000. Tenants were moved out in July 1965 and returned five months later.

Subsequently, the other buildings were rehabilitated and the last tenants returned in August 1967. Reconstruction time for each building was typical of rehabilitation at this time. The time period from "tenants relocated" to "tenants returned" varied. For three buildings, it was approximately five months; for one, it was eight months; and for two buildings, it was thirteen

months. The time from acquisition of buildings to FHA commitment varied from six months to one year. This also was typical of the best FHA processing at the time. In New York City, it then took from three to five years for planning, processing, construction and full occupancy of new publicly assisted housing (14).

Acquisition costs for the buildings varied from $30,000 to nearly $45,000 each. Physical rehabilitation costs averaged $8,300 per living unit. Total cost of acquisition, demolition, reconstruction, tenant relocation, etc., was $15,200 per living unit. Typical total development costs for new public housing construction in Manhattan during this period were $19,000 to $30,000 with a median of about $25,000 (14).

The Company's interest in rehabilitation derived from the belief that large new market opportunities existed for building products, if a large national rehabilitation industry became established (16). By entering the business itself, U.S. Gypsum Company could test new products, develop special products for rehabilitation, stimulate other large corporations to purchase and rehabilitate buildings -- thus contributing to growth of the industry, and in general, gain knowledge of the problems involved and their solution. Financed under Section 233, the costs incurred in the buildings on 102nd Street were fully covered by a mortgage. The Company then bought six more buildings on 103rd Street and five more on 130th Street and on Lexington Avenue, and rehabilitated them under Section 233. These costs also, were fully covered by mortgages. However, the Company then undertook projects in Cleveland and Chicago which were not financed under Section 233. Overcosts were experienced which they had to cover, and the program was judged too costly to continue.

On the first building in New York City, more than a dozen of the Company's products were tested. These included electrically heated gypsum ceiling panels, a one-coat spray-on plaster, solid gypsum block walls, and a plastic material for leveling floors.

Other New York City Projects

A number of additional rehabilitation projects were completed in New York City with various experimental features. The Park Slope Project in Brooklyn used some of the materials and components developed in the East 5th Street project such as, the adjustable windows. However, none of these projects appeared to involve any additional important technological research or experimentation.

Pittsburgh, Penna.

Beginning in 1965 and continuing into 1969, when the activity was merged into Project Rehab, several projects, involving 278 units, largely in single-family structures, were rehabilitated in the Homewood/Brushton area of Pittsburgh (17).

First, 22 units were completed on Cora Street involving a mortgage of $238,000 and approximately a one-year construction period. The next project included 66 units requiring one-year and seven months for construction. Beginning in September 1968, a project with 145 units was finished in one-year and seven months, and finally a project with 45 units was finished in seven months. The total mortgage was $4,196,500 or about $14,100 per unit.

Only one significant technological innovation was included in these projects -- an acrylic plaster spray, which it was hoped would reduce construction time by 50% and reduce construction costs by 15%. Such hopes were not realistic, since interior wall surfacing, although an important time and cost element, does not represent such a significant part of the total cost. In any event, in time the material developed widespread cracking and was found unreliable (18).

Cleveland, Ohio -- Belvidere

In 1966, an experimental rehabilitation of two contiguous buildings in the Hough area of Cleveland was begun. The properties (6215 and 6303 Belvidere Avenue) built in 1904 were four-story, brick structures containing 22 apartments and were considered to be in marginal physical condition. Acquisition cost was $22,000, and the rehabilitation cost was originally estimated to be $140,000 or $8,700 per unit. New baths, kitchens, plumbing and heating, windows, stairs and rear porches were installed. Other improvements also were included.

This project was chosen following the riots in the Hough area in July 1966. It was hoped (19) that, in addition to showing rehabilitation could produce decent housing for less cost than new construction, this one project would stimulate others in the area, and thus show the way to upgrading a depressed neighborhood. Also, the project was managed by a local grassroots organization, HOPE (Housing Our People Economically), and a success here might encourage other local groups to aid in revitalizing the neighborhood.

Among the experiments in this project were two involving technology. Customarily, badly cracked plaster walls were stripped of plaster before new lath and plaster was applied. In this project, new lath and plaster was applied directly over the old plaster. At conclusion of the project, the rehabilitation contractor (20) felt that additional study would be required to determine whether this technique had resulted in any actual cost savings.

Another experiment involved plastic pipe for plumbing. Plastic was accepted by both FHA and the City of Cleveland for drain, waste and vent (DWV) piping. However, neither had accepted plastic piping for hot and cold water lines. B.F. Goodrich, the developers of Geon plastic pipe cooperated on the use of a chlorinated polyvinyl chloride (CPVC) heat resistant pipe in these buildings.

Cost savings of 25% on the entire plumbing installation were estimated to be due to the use of plastic pipe. The experience gained in the project resulted in national FHA acceptance of CPVC for hot and cold water piping. No other technological experiments were involved in this project.

Boston, Mass. -- Boston Rehabilitation Plan (BRP)

In 1967, a major experimental rehabilitation program was undertaken in Boston. It proposed the rapid rehabilitation of 2070 units in 101 buildings over an 18-month period (21). Up until this time, the Federal government experimental rehabilitation programs had been accomplished mostly by small and marginal operations and carried out on a limited scale. Most of them had directed major attention at overcoming the institutional barriers, especially FHA processing time. However, even after six years of such efforts, FHA was still broadly criticized for requiring six to twelve months, and in extreme cases, up to eighteen to twenty-four months to process a rehabilitation project. Such processing delay can be a most troublesome problem with a developer, and may well cause a project to fail. During such protracted periods, cost estimates become meaningless, scheduling is impossible, etc.

This mounting criticism prompted HUD to undertake a "controlled experiment" under the Boston Rehabilitation Plan in the Roxbury/North Dorchester community. The experiment was devised to test two hypotheses (22):

1. FHA could entertain, receive, and process applications involving over 2000 units in over 100 buildings in 60 days.

2. Experienced rehabilitation developers could complete and have the 2000 units ready for occupancy in eight months.

The project proved the first hypothesis, and the Boston FHA office processed $24 million of commitments in less than 60 calendar days. The construction effort fell somewhat short, although 1500 units were completed in

the first year and the balance within 18 months -- a truly remarkable accomplishment.

The construction was hampered by very bad winter weather, but perhaps more by furor within the neighborhood and the community, caused, some say (18), by insufficient attention to the social or human-factor problems inherent in the rehabilitation of occupied structures. From the viewpoint of the experimental objectives, the project was successful and served as a basis for Project Rehab which followed.

No important technological experimentation was involved in the BRP project.

Project Rehab

In 1969, HUD undertook to marshall its resources and, using the knowledge and experience gained from the numerous rehabilitation projects dating back to 1961, launched Project Rehab. It was planned as a national demonstration that rehabilitation on a large scale could be accomplished throughout the United States, and that a "critical mass" could be reached which would foster the development of an efficient, capable and continuing rehabilitation industry (18).

Early in its development stage, decision was made to direct attention to those barriers which had to be overcome in order to build an on-going program and to avoid or somehow ignore those constraints which could successfully be avoided or ignored. Consequently, the major components of Project Rehab program planning were directed towards overcoming institutional barriers -- HUD processing, city participation, labor relations, financial institution support, etc. Social concerns also were interwoven into the program planning, and citizen participation was carefully cultivated. Cities and neighborhoods were carefully selected, relocation assistance was provided and the programs were

carefully coordinated with other related local programs.

In conformance with the program objectives, technological research was completely set aside. New methods or materials which might delay or hinder the program were avoided. Cities were not asked to make code concessions which would make it more difficult to obtain the full cooperation of all local officials.

Many of the buildings rehabilitated during this project were gutted regardless of condition. That is, walls were stripped to the studs and completely rebuilt. Roofing material was removed and although old plumbing pipes and wiring often were not removed, they usually were completely replaced with new materials. This technique minimized the difficulty of estimating the construction cost of rehabilitation. The contractor could more clearly ascertain precisely what would be required to be done and thus he entered into the reconstruction job with much greater confidence in his cost estimates. Uncertainties were largely limited to foundations, sewer lines, and possibly a few rotting structural members around bathrooms and kitchens.

On the other hand, the gutting technique results in reconstruction and replacement of materials which may not really be necessary. Thus, reconstruction costs may be increased unnecessarily and marginal buildings rejected for rehabilitation. More sophisticated techniques for ascertaining more precisely what does and what does not need to be torn out and replaced could avoid these problems.

An important objective of Project Rehab was to identify new materials and techniques, to improve efficiency or reduce cost. However, no such new materials or techniques were identified during the project. No new technology appears to have been employed and no contractor undertook an experimental or unusual approach (18).

Nevertheless, Project Rehab used many of the new materials and

techniques development in earlier HUD experimental rehabilitation work. Drop ceilings which were so successfully used in the East 5th Street project in New York City to simplify installation of new wiring and heating ducts were included. Plastic pipe, introduced in the Cleveland (Belvidere) project, was used extensively and its widespread use was cited as "... probably the most significant technological improvement in the program" (18). Foam concrete was used to level floors prior to installing the finish floor material. Similar techniques had been experimented with in New York City on West 114th Street and in the U.S. Gypsum Company projects.

In its Monitoring Report on Project Rehab (18), Arthur D. Little, Inc. has recommended further research to develop materials or techniques that could improve rehabilitation technology and reduce costs.

Project Rehab Accomplishments

Project Rehab has been successful in building a massive rehabilitation program (23). It has learned better how to cope with the institutional and social problems on a large nationwide scale. While it has not significantly advanced rehabilitation construction technology, it has utilized many of the new materials and techniques which had been developed in earlier programs.

From its inception to the end of 1972, it has rehabilitated over 53,000 living units. Typically, construction required 18 months for projects involving from 50 to 200 units each. Processing time, typically was less than two months per project. New construction in the same localities is said to require about 22 months for processing. Average development costs for rehabilitation was $14,906 per living unit compared to $20,158 for new construction in Project Rehab cities -- more than 25% lower (24).

No conclusions can be reached regarding the degree of success in stimulating a continuing national rehabilitation industry because the present absence

of subsidy funds precludes continuing this kind of program. Project Rehab is now winding down -- honoring its outstanding commitments. It is believed that some "economies of scale" were obtained in the project, because of its mass. However, cost data to support this view are not now readily available (24).

OTHER REHABILITATION TECHNOLOGY RESEARCH

Structural Load Testing

In New York City, and elsewhere, especially when masonry buildings are involved, one of the problems results from a lack of a clear understanding of the structural soundness of such buildings. On the East 5th Street project, it was felt that much unnecessary cost had been incurred in repairing the old, brick walls because of this lack of understanding.

As a start towards the development of an FHA structural inspection manual for existing buildings, a full-scale structural load test program was carried out on East 89th Street (25). A five-story building scheduled for demolition was obtained from the City. Various structural elements: walls, floor joists, brick lintels over openings, etc., were loaded to failure. Construction Research and Development Corporation of New York, Washington and Los Angeles, was employed to carry out this work. A report on the tests and conclusions reached by them was prepared (25). The results, while very informative, are of limited usefulness since only one building was tested. Further tests of this kind are needed.

Add-On-Bathroom

The use of modular bathroom and kitchen assemblies in the East 5th Street project in New York City gave rise to the thought that similar units might be added-on to existing structures to provide bathrooms and kitchens where none existed, or to provide additional space in the rehabilitated living units. Attempts to test this concept in the Pittsburgh, Penna. projects were not successful. Project Rehab also considered such a scheme (18).

More recently (1972) HUD contracted with the South Carolina State Housing Authority to research the Add-On-Bathroom feature for housing lacking

some or all plumbing facilities. A prototype sandwich panel add-on bathroom was designed but efforts to devise a marketing strategy for it were unsuccessful. A wood-frame modular unit was then substituted and limited production followed. Problems are set forth in a draft report (26) as are recommendations based upon the study. The major problem seemed to be an absence of financing available to the lower-income families which would most benefit from this concept. This problem ought to be solvable.

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