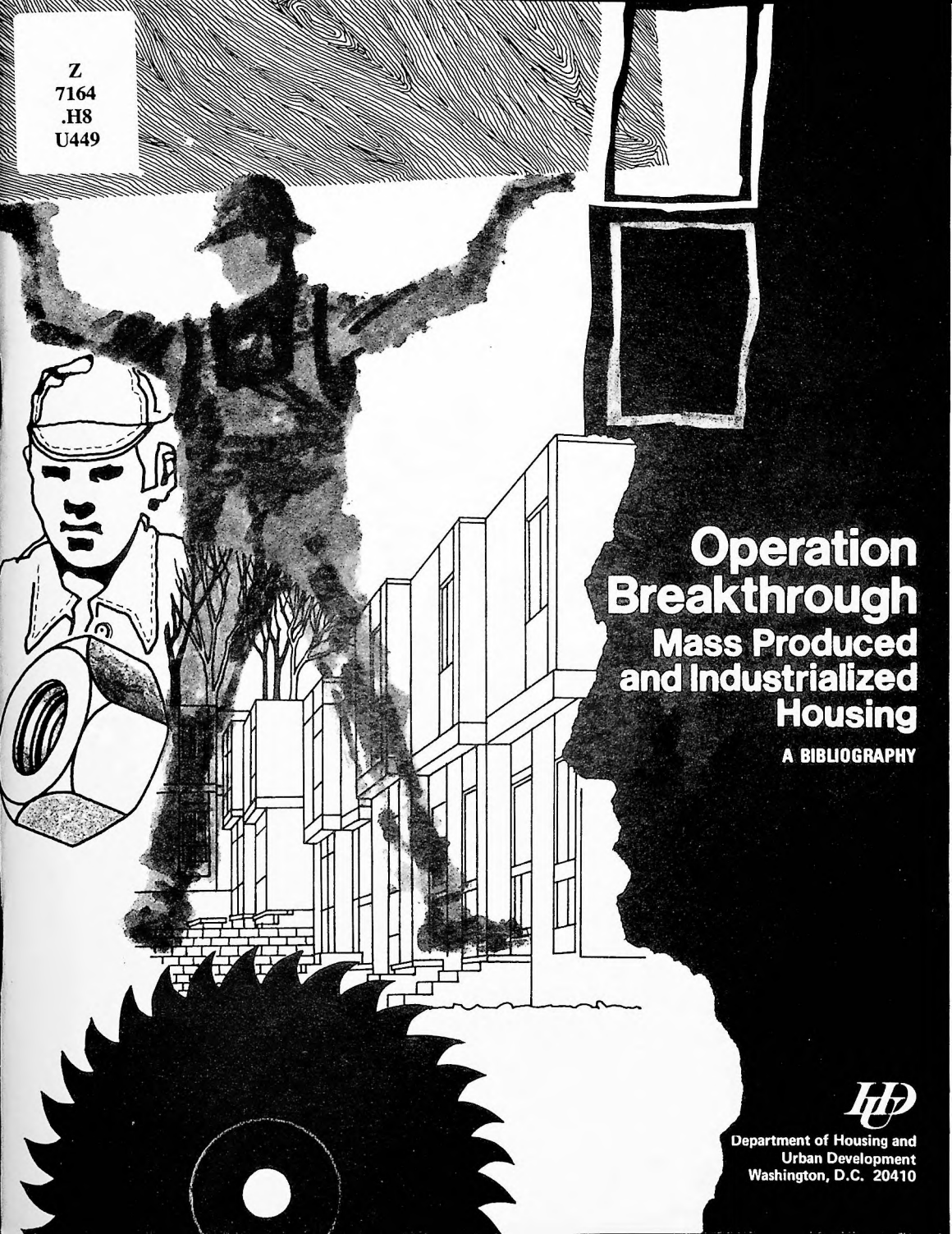


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Operation Breakthrough Mass Produced and Industrialized Housing

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Operation Breakthrough Mass Produced and Industrialized Housing

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FOREWORD

Breakthrough "is not a program designed to see just how cheaply we can build a home but a way to break through to total new systems of housing construction and marketing."

George Romney, Secretary
U.S. Department of Housing
and Urban Development

These selected references are aids in the construction aspects of the program - the application of modern industrial technology to building.

European and domestic experiences in modules and prefabricated building systems are presented. The hope is to stimulate new systems that will exploit our advanced technology. This should enable us to supply housing for all citizens at a faster and less costly rate than would be possible through conventional methods.

This annotated bibliography has been compiled by the HUD Library to provide sources of information for the increasing number of people who are becoming aware of the potential of industrialized building. Books, reports and periodical articles, primarily those dating from 1965, have been arranged to lead from the general to the specific. Also included are two lists: titles and addresses of periodicals which are devoted wholly, or in part, to the subject, with annual subscription rates; and names and addresses of publishers of cited publications.

Call numbers in parentheses are those of the HUD Library. HUD personnel may obtain books and journals indexed in the bibliography through Central or Regional Libraries. Non-HUD personnel should borrow from local libraries, or order from the publishers. U.S. Government publications may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D. C., 20402. Items available from the Clearinghouse for Federal Scientific and Technical Information should be ordered by their PB number, at \$3.00 each. The address is 5285 Port Royal Road, Springfield, Virginia, 22151.

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The objective of this study was the utilization of technological innovations in industrialized building systems and in mechanical and service systems in an effort to make Fort Lincoln a national urban technology "proving ground." Thirty building systems were surveyed and analyzed for technical data, labor, economic, and construction factors. The conclusion was that no one system as designed could meet the needs of the FLNT program, but that compromises could be worked out among several systems.

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FHA 223 (experimental housing) townhouses -- upper and lower level bolted together -- create Fredella Village in Vicksburg, Miss.

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Research Institute Application of Component Construction to Multi-story, Low-income Housing; final report, by E. B. Fowler and others. Chicago, 1968. 3 v. (U.S. Dept. of Housing and Urban Development. Demonstration Grant Program) (693.068:389.6I55a)

Description of planning and production of three dimensional concrete room-size modules by factory methods to conform to design of floor plans for one-, two-, and three-bedroom apartments. A literature survey and annotated bibliographies on concrete building systems design and modeling are included in Volume III, together with an analysis of structural aspects and cost data.

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MXC; Minnesota Experimental City. Progress report. Minneapolis, 1969. 5 vols. (U.S. Dept. of Housing and Urban Development. Urban Planning Research and Demonstration Program) (711.417(776)M45)

Appendix A: A compendium of publications relating to socio-cultural aspects.

Appendix B: Economic and physical aspects.

Appendix C: Areas for study and experimentation.

Appendix D: Bibliography

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The findings of this report derived from an intensive study of six Low-Income Housing Demonstration projects, five FHA Experimental Housing projects, and Habitat '67. The projects are grouped by technological similarity and compared with other applications of similar techniques. None of the new construction technologies examined has demonstrably cut direct construction costs below those of conventional methods.

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IBIS [Integrated Building Industry System] Final report.
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Development. Low-income Housing Demonstration Project)
(728.1N67)
To illustrate use of computers for cost and design
analysis.
76. Pratt Institute, Brooklyn. School of Architecture.
Cost Reduction Methods for High-Rise Apartments. Brooklyn,
New York, 1967. 69p. (U.S. Dept. of Housing and Urban
Development. LIHD Project (728.2(74811)P71)
77. Rowland, Norman.
Reston Low Income Housing Demonstration Program: a re-
port on factory produced multi-family housing utilizing
light-gage steel modules, by Norman Rowland and Margaret
Drury. Washington, 1969. 1 v. (U.S. Dept. of Housing
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Program) (728.1(75529)R68)
This report contains the plan for a new system that can
rapidly increase the production of housing at substantial
cost savings. Construction of three prototype modules
at Reston, Virginia provided exact material and labor
inputs as well as an understanding of the complexity
of mass factory production. Available from the Clear-
inghouse for Federal Scientific and Technical Informa-
tion. (PB 183 968)
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Ten houses, each utilizing a different building system,
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Cost Reducing Condominium Systems for Low-Cost Homes.
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Dept. of Housing and Urban Development) (334.1S92)
80. "10 low cost systems and how to make them work." Professional
Builder, March, 1969, p. 87-91.
The technological aspects of the ten experimental houses
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teamwork is necessary in order to take full advantage
of new methods. The project was funded by HUD.

81. U.S. Dept. of Housing and Urban Development. Federal Housing Administration.
Fredella Village; a housing demonstration: a report. Washington, 1968. 11p. (F/TS-27) (693.002.22F22f)
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82. U.S. Dept. of Housing and Urban Development.
In-Cities Experimental Housing Research and Development Project; phase 1, composite report. Washington, 1969. 4 v. (728.1H68inc)
A systematic analysis of the urban housing production process was carried out and, simultaneously, field investigation was made of 56 cities to select those which could best host experiments aimed at easing the major institutional, human and technological constraints on the construction of low cost housing. Available at the Clearinghouse for Federal Scientific and Technical Information. Vol. I, (PB 184 121); Vol. II, (PB 184 122); Vol. III, (PB 184 123); Vol. IV, (PB 184 124).
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Supply Conditions for Low-Cost Housing Production. Arlington, Va., Institute for Defense Analyses, Program Analysis Div., 1968. 115p. (Study S-323 Conducted for Dept. of Housing and Urban Development) (728.1W24)

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It's an opportunity to solve the housing problem and to bring private industry into the solution.
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"Operation Breakthrough: a good idea - but!" Automation in Housing, Aug., 1969, p. 50-51.
It's trying to do too much, too fast.
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"Operation Breakthrough: a nationwide effort to produce millions of homes." HUD Challenge, Nov./Dec., 1969, p. 6-9.
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112. Bishop, D.
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METHODS AND MATERIALS

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Shows versatility of polyurethane, a plastic material used for coatings, insulation, etc. Examples of use are cited, in which reinforcement and shape are important. Illustrates a foldaway accordion pleated shelter, a paper-laminated urethane foam prototype low-cost structure and an instant inflated igloo.
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"Mass-produced British plastic houses." Automation in Housing, Feb., 1970, p. 110-114.
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"Mounting accuracy of prefabricated building components." Build International, April, 1969, p. 14-18.
Methods, techniques and instrumentation to obtain accuracy are now being devised. Author is member of State Committee on Civil Constructure (sic) and Architecture, USSR.
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Stack-up housing in Amherst, Mass. financed by FHA.

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Use of plastics in building systems will increase when building codes are modified and the construction industry's suspicions are allayed.
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Construction of an Oakland, Calif. retirement center will be completed in 10 months as compared to 16 for conventional methods.
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Factual, comprehensive review of new technology and why it has largely failed. Failures include: sectional houses of steel, aluminum, etc., because of inflexibility, cost of transport; sandwich panels are not really cheaper and present problems in joining; roofing and doors failed due to consumer resistance; plumbing cores and walls created inflexibility and transport cost. Successes were trusses and sheet materials. Future possibilities include wiring harness, plastic plumbing, steel foundations.
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Sp. (Current Paper 5/68) (690.22K25)
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"What's happening in vinyl siding?" Modern Plastics, Dec., 1969, p. 86-87.
Big boom in sales spurs fierce competition and consideration of new production techniques.

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"Comprehensive architectural practice; architecture and industrialization." American Institute of Architects Journal, Sept., 1963, p. 59-72.
How comprehensive service can lead to future accomplishments in mass-produced, standardized and interchangeable components for building.
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"A case for the new technology." Constructor, Sept., 1967, p. 42-47.
Author describes the production of prefabricated concrete load-bearing wall panels made in his factory.
249. "Miracle? No, modular." Systems Building News, March, 1970, p. 88-90+.
The Matador Motel in Jacksonville, Fla. was built in a month using components built at a factory 300 miles away.
250. Modular Building Standards Association.
Modular Practice; the schoolhouse and the building industry. Edited by Robert P. Darlington, and others. New York, Wiley, 1962. 198p. (NA2750M72-1962)
251. "Modular standard due this fall." Architectural and Engineering News, Aug., 1968, p. 25-27.
If industrialization is to catch on as the way to supply the housing needed within the next decade, architects, builders and manufacturers must take lessons from the country's industrial giants: housing must be assembled from interchangeable components that fit and work together.
252. Mosher, Lawrence.
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The new town of Jonathan, Minnesota, 25 miles southwest of Minneapolis, is having problems because of the tight money market. But hope lies with a "flexible" house that can expand or shrink according to family needs, and a 24-by-48 module that can be stacked in any number of positions to provide low-income housing for rent or purchase.
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A prototype house design that begins with 2 bedrooms and, with add-on modules, can go to four as need arises.

254. "A new kind of total house." Better Homes and Gardens, Sept., 1969, p. 74+.
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255. "New shapes in reinforced concrete roofing." Southern Builder, Dec., 1965, p. 9-10.
Duke University engineer says his shell concept could provide breakthrough in low-cost housing.
256. "New ways to cut costs." Buildings, March, 1969, p. 48-53.
Describes some new ideas, methods and materials that will cut the budget on multi-family housing construction.
257. "Open system U.S.A." Architectural and Engineering News, June, 1967, p. 70-73.
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Texas lumber dealer-component manufacturer adopts dovetail frame connector system; efficiency up over 50% in the first year.
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Plastics in Building Structures. Proceedings of a Conference held in London, June 14-16, 1965. Oxford, Pergamon Press, 1966. 320p. (TA455.P6P618)
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The creation of instant space for hotel and housing projects.
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264. "The relocatables." Automation in Housing, Oct., 1968, p. 66-70.
A closeup look at the latest in portable classrooms.
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"Large-panel construction in the USSR." Build International, May, 1969, p. 18-21.
A method ensuring the greatest quality production in the shortest possible time.
266. Seymour-Walker, K. J.
Developments in Production of Concrete Panels. Garston, England, Building Research Station, 1968. 12p. (691.32S29)
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267. Seymour-Walker, K. J.
Vertically Cast L-Shaped Panels. Garston, England, Building Research Station, 1968. 4p. (Current paper 16/68) (693.002.22S29)
The manufacturing technique is briefly discussed and a comparison is made between the cost of these panels and other systems of building.
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Interviews with four consulting engineers who have pioneered the role of the engineer in packaged buildings.
269. "Stacking with steel." Automation in Housing, Dec., 1967, p. 25-26.
Steel has found its way into two factory-fabricated building projects; one in Michigan City, Ind., and the other at Trinity Christian College in Baton Rouge, La.
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"Relocatable buildings used for instant, economical and disposable campuses." College and University Business, Feb., 1969, p. 90-96.
Prefabricated, packaged systems enable colleges to "buy time" for growing.

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Aluminum-skinned house telescopes from an 8-foot width into three sections. Designed, built and tested in Sweden.
272. "They're stacking them up all over." Automation in Housing, Dec., 1967, p. 22-24.
Stacked modular sections provide "instant" finished townhouses and apartments.
273. "21 stories - 35 days." Automation in Housing, Feb., 1968, p. 58-61.
Stacked concrete box construction helps H.B. Zachry Co. set records in building Hilton's new hotel in San Antonio.
274. "Two precast structures cushioned by neoprene." Architectural Record, Dec., 1969, p. 135-137.
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Co-ordination of Components in Housing; metric dimensional framework. London, H.M.S.O., 1968. 43p. (Design bulletin 16) (693.068:389.6U54c)
276. U.K. Ministry of Public Building and Works.
Dimensional Co-ordination for Building; recommended dimensions of spaces allocated for selected components and assemblies used in educational, health, housing and office buildings. London, H.M.S.O., 1968. 16p. (D.C.8) (693.068:389.6U54di)
277. United Nations. (Dept. of Economic and Social Affairs)
Modular Co-ordination in Building; Asia, Europe and the Americas. New York, 1966. 67p. (ST/SOA/62 E/C.6/36/Add. 9/Rev. 1) (693.068:389.6UNm-1966) (NA2750U658)
"A study of the status of modular co-ordination in different geographical regions, with emphasis given to existing standards approved by national organizations responsible for research in this field."
278. United Nations. (Dept. of Economic and Social Affairs)
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Includes chapters on basic concepts of modular coordination, design considerations, and proposals for the future, as well as examples of modular housing from different countries.
279. United Nations. (Economic Commission for Europe)
Cost, Repetition, Maintenance; related aspects of building prices. Geneva, 1963. 165p. (ST/ECE/HOU/7) (690.031(4)UN) (TH435U65)

Contains numerous charts, graphs and tables concerning optimum size and production runs for prefabrication plants in Sweden and Czechoslovakia. Also discusses the economic significance of maintenance and the problems of durability.

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Modular Coordination in Low Cost Housing, by Alvaro Ortega of the United Nations Technical Assistance Operations Board assigned to the Central American Economic Cooperation Committee. New York, 1961. 114p. (Document E/CN 12/CCE/SC.4/9/TAO/LAT/35) (693.068:389.6(8)UNm)
Describes design modules used in the United Kingdom and El Salvador; gives suggested modular sizes of building components; gives modular coordination standards for twelve countries.
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Manual on Wood Construction for Pre-fabricated Houses. Prepared in collaboration with the Forest Products Laboratory, Forest Service, U.S. Dept. of Agriculture, Madison, Wis., for the use of the Agency for International Development. Washington, reprinted 1967. 330p. (694.1F67m)
282. U.S. Dept. of Housing and Urban Development. Division of International Affairs.
Prefabricated Concrete Components for Low-Cost Housing Construction. For the use of United States A.I.D. Missions. Washington, reprinted 1967. 34p. (Ideas and Methods Exchange no. 59) (690H68 IMEA no. 59)
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Wood Components for Preengineered Building Systems? Portland, Or., 1967. 16p. (VF694.1P12)
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"Tolerances and fits." Build International, April, 1969, p. 19-21.
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"Module concepts through wood technology." Building Research, Jan./March, 1969, p. 29-30.
Describes the characteristics, advantages and disadvantages of wood frame modular construction.

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"Trend to prestressed long span floors in European industrialized systems." Apartment Construction News, March, 1970, p. 23-25.
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"SCSD: pioneer effort in systems approach to building construction." Civil Engineering, April, 1969, p. 41-45.
History, progress and success of the School Construction Systems Development (SCSD) project in California.
288. "Assembly line houses European." Constructor, Sept., 1969, p. 21-23.
European contractors turn out apartment buildings about the same way Detroit builds automobiles. Explains the Camus and Coignet building systems.
289. "Assembly line systems." Professional Builder, April, 1969, p. 80-83.
Brief descriptions of the systems of several companies.
290. "Building Systems Development, Inc." Architectural and Engineering News, Aug., 1968, p. 58-59.
Ezra Ehrenkrantz and project URBS (University Residential Building Systems)
291. "Building system given dual role." Engineering News-Record, Dec. 4, 1969, p. 28, 34.
The Firnkas system, that has produced over 2000 dwelling units, has been modified for use as an office building system.
292. "Carl Koch concrete assembly system." Progressive Architecture, June, 1968, p. 141-145.
Precast concrete structural elements are assembled on site to contain prepackaged interior components; construction is scheduled by computer.
293. "Case studies." Architectural and Engineering News, Aug., 1968, p. 21-24.

- Case 1: Assemble your own floor plan with Techcrete pre-cast units. Case 2: Expand as you go with Neal Mitchell Associates' framing system. Case 3: Use Hirshen and Van der Ryn prepackaged "cores." Case 4: Robert Martin Engelbrecht and Associates' vacation house module. Case 5: Building Block Modules, Inc. have developed stacked concrete boxes.
294. "Coignet and Balency: CONSTRUCTOR reports on two highly industrialized building systems." Constructor, Feb., 1970, p. 28-35.
Large panel systems require high quality machines housed in a rigidly controlled, sophisticated production factory. The basic system has wide flexibility and adaptability.
295. "Cosmos: the first open system for housing." Architectural and Engineering News, May, 1969, p. 37-40.
Kit-of-parts and computer control provide complete sub-systems for British houses.
296. Davis, James.
"Prefabrication." Constructor, Oct., 1968, p: 17-24.
Examination of projects using the Zachry Co. and Uniment methods.
297. Diamant, R. M. E.
"Economy systems use many materials." Automation in Housing, Feb., 1968, p, 62-65.
Report on two of Great Britain's most successful economy building systems which combine many materials for frame and curtain wall.
298. Diamant, R. M. E.
"House or high rise - one system does all." Automation in Housing, Dec., 1967, p. 34-36.
Report on a versatile brick prefab system from the Skara Tegelbruk firm in Sweden.
299. Diamant, R. M. E.
"A new angle on building." Automation in Housing, Feb., 1969, p. 68-71.
Skanska Cement Co., Sweden, precasts L-shaped angle units which are cast, stored and transported in a vertical position.
300. Diamant, R. M. E.
"This building is plastic." Automation in Housing, Oct., 1968, p. 59-61.
The Inca system, a plastic substitute for brick, invented by a British architect, cuts costs of laying, reduces need for cavity work and plastering.

301. Diamant, R. M. E.
"Three sided flexibility." Automation in Housing, Dec., 1969, p. 65-68.
The German company Trelement Design of Lerchesbergring, West Germany, has introduced a revolutionary, completely flexible prefabrication system employing a planning grid of equilateral triangles with a side length of 7'6".
302. Diamant, R. M. E.
"Two from Sweden." Automation in Housing, Aug., 1969, p. 60-64.
Houses built completely in the factory: Lunnavilla and the Atrium house.
303. "Diversification at Dual-Wide." Automation in Housing, Aug., 1967, p. 42-45.
New markets, materials spell success for this fabricator of relocatable structures.
304. Educational Facilities Laboratories.
SCSD [School Construction Systems Development]: the project and the schools; a report from Educational Facilities Laboratories. New York, 1967. 95p. (727.1(794)E28)
History of the SCSD project and the finished school.
305. Escott, G. K.
"Jespersen-Kay: about twice as fast as conventional methods." Ontario Housing, vol. 15, no. 2, 1969, p. 6-7.
Describes factory built housing produced by Jespersen-Kay Systems, Ltd. of Canada.
306. "Factory-produced units cut costs by 20 percent, speed construction." California Builder, April, 1968, p. 14.
Richmond 24-unit Uniment -- bearing walls 2" thick, no joints.
307. "Finally: a low-cost component system for housing that really works." Architectural Record, March, 1967, p. 187-194.
Carl Koch's Techcrete system avoids design restrictions, uses simple components, works equally well for low- or high-rise.
308. Firnkas, Sepp.
"Utilizing prestressed, precast systems." Building Research, April-June, 1968, p. 28-31.
The author gives the history, economy and erection procedures for the "tech-crete" system his firm has developed.
309. "Four men erect eight low cost apartments in one day." (Rancho de los Penasquitos, Cal.) Practical Builder, Nov., 1967, p. 56-59.

Precision engineered components, manufactured by Rheem-Dudley and delivered by tractor-trailers from factory to prepared site, built 42 four-, six-, and eight-plex structures that provided 248 units.

310. "Four variations: rapid economical production of mass housing."

Progressive Architecture, Feb., 1970, p. 74-85.

New Haven architects Wojciech and Urszula Lesnikowski created a building system called "Urban Organic, Modular, Element." The configuration and space required for one dwelling represents the key design element. Structurally, this element has as its base a cross-shaped floor slab supported at four locations on its periphery and in such a manner that optimum structural performance of the floor is assured.

311. Giddens, T. J.

"'No-Fines' Concrete Construction - Wimpey's building system."

Ontario Housing, vol. 15, no. 2, 1969, p. 12-13.

Approximately 50% of the industrialized housing in the United Kingdom is carried out by the No-Fines Concrete System, containing cement and coarse aggregate only, instead of the usual fine aggregate.

312. Godfrey, Kneeland A., Jr.

"New technology in low-income housing." Civil Engineering, Jan., 1968, p. 48-55.

Five systems are described: Michigan City, Ind.; Carl Koch's Techcrete; LeMessurier; URBS; SCSD.

313. Hanson, J.

"Wates System: precast concrete construction." Ontario Housing, vol. 15, no. 2, 1969, p. 10-11.

Modular Precast Concrete Structures, Ltd., of Canada, will introduce the Wates System which is basically a large, precast panel technique of interlocking wall and floor elements.

314. Heifetz, Haim.

"Developments in inflatable forms." Build International, Jan./Feb., 1970, p. 25-35.

Domecrete structures, which are built by spraying concrete onto an inflated balloon, are not new, but have not been utilized as frequently as other building systems. Their advantages are: a minimum of equipment, high efficiency, low costs, and earthquake resistance. In Israel, in the Sinai Desert, hundreds of structures are being built by this method.

315. "Here's the world's first all-plastic housing system to go into production." House and Home, Jan., 1970, p. 94, 100.

Factory-built and marketed in Mexico it produces houses for from \$400-\$2000; local materials are used on the interiors.

316. "How Baltimore schools may break the time barrier." Architectural and Engineering News, April, 1969, p. 36-37.
Use of the industrialized construction methods of the Architectural Affiliation of Towson, Md. will streamline the construction period by as much as 75%.
317. Hurley, David J.
"URBS: systems for the University of California." Architectural and Engineering News, June, 1967, p. 46-47.
Gives background, description and state of URBS system. Describes approach being used, criteria for development, emphasizing maintenance, possible market, and major categories of system development: structural system, mechanical, partitions, casework and furniture, bathrooms.
318. Katselas, Tasso.
"Technology and the apartment." Architectural and Engineering News, Feb., 1964, p. 28-29.
Describes two projects using precast concrete, by Tasso Katselas, as an example of applied technology. Also mentions factory built apartment units by Ken Fryar Associates in Michigan City, Indiana, developed under Housing and Home Finance Agency's low-income demonstration program.
319. Koch, Carl, Jr.
"Component design for the urban environment." Building Research, Jan./March, 1969, p. 11-15.
Author traces the history of instant space ideas in his firm's work to illustrate some of the pros and cons of totally-manufactured modules.
320. "Michigan/Aerojet spun glass cocoons." Progressive Architecture, June, 1968, p. 146-149.
Rectangular units of spun glass and polyester are wound around a steel mandrel at the housing site.
321. Michigan, University. Architectural Research Laboratory.
Research on Potential of Advanced Technology for Housing; a building system based on filament winding and new developments in water and wastes management. Ann Arbor, 1968. 85p. (693M42)
Prepared in association with Aerojet-General Corporation.

322. Miller, Buckley and Coignet, Ltd.
The Coignet system. Hayes, England [1967?] 16p. (690.022M45)
323. "Mobile factories." Constructor, Dec., 1969, p. 21-26.
"Mobile factories are tailor-made for medium size housing projects in areas where big markets for systems building have not developed." Discusses the CEBUS, Pascal and Foulquier systems.
324. National Lumber Manufacturers Association.
Fabrication of Components. Washington, National Lumber Manufacturers Association, Technical Services Div., 1963.
1 v. (UNICOM manual no. 2) (FOLIO 693.068:389.6N17f)
On cover: The UNICOM method of house construction.
325. O'Grady (John F.) Inc.
Parkhouse Building Construction Systems. Apartments, student apartments, student dormitory, hotel, motor inn, convalescent facility, educational facility. Los Angeles, 1967. 1 v. (693.002.22037)
326. "One man breakthrough--a plant and a plan for housing profits." Professional Builder, March, 1970, p. 64-72.
Creative Buildings, Inc. is an example of a small builder (Ray Murphy of Urbana, Illinois) who has assembled ingredients and skills into an effective architectural-building team that started with packaging church projects and is now in multi-family housing.
327. Page, Clinton A.
"SEF: first open system for schools." Architectural and Engineering News, May, 1969, p. 41-42.
Toronto's School Board moves ahead.
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Universal Papertech Corp. of Hatfield, Pa. is mass producing paper houses that combine attractiveness and economy with fast erection and permanence. Because the design is modular, it offers a variety of housing shapes and sizes.
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Describes a series of possible solutions to the housing shortage using mobile home units to build low-cost high-rise housing. Part 2 concerns a project sponsored by Dept. of Housing and Urban Development: trailer-like units 12 feet wide are linked to form 3-story development at 40 families per acre density. (See item # 71)

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No form of building typifies the inevitably 'industrial' approach to housing more than does the mobile home in its various avatars and mutations. It can be added to and otherwise adapted to the changing requirements of a single family, as well as renovated by replacing components. It can be traded in on a new model, thereby making available another type of low-cost used housing.

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Special editorial; lists members of the Commission, including George Romney.

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