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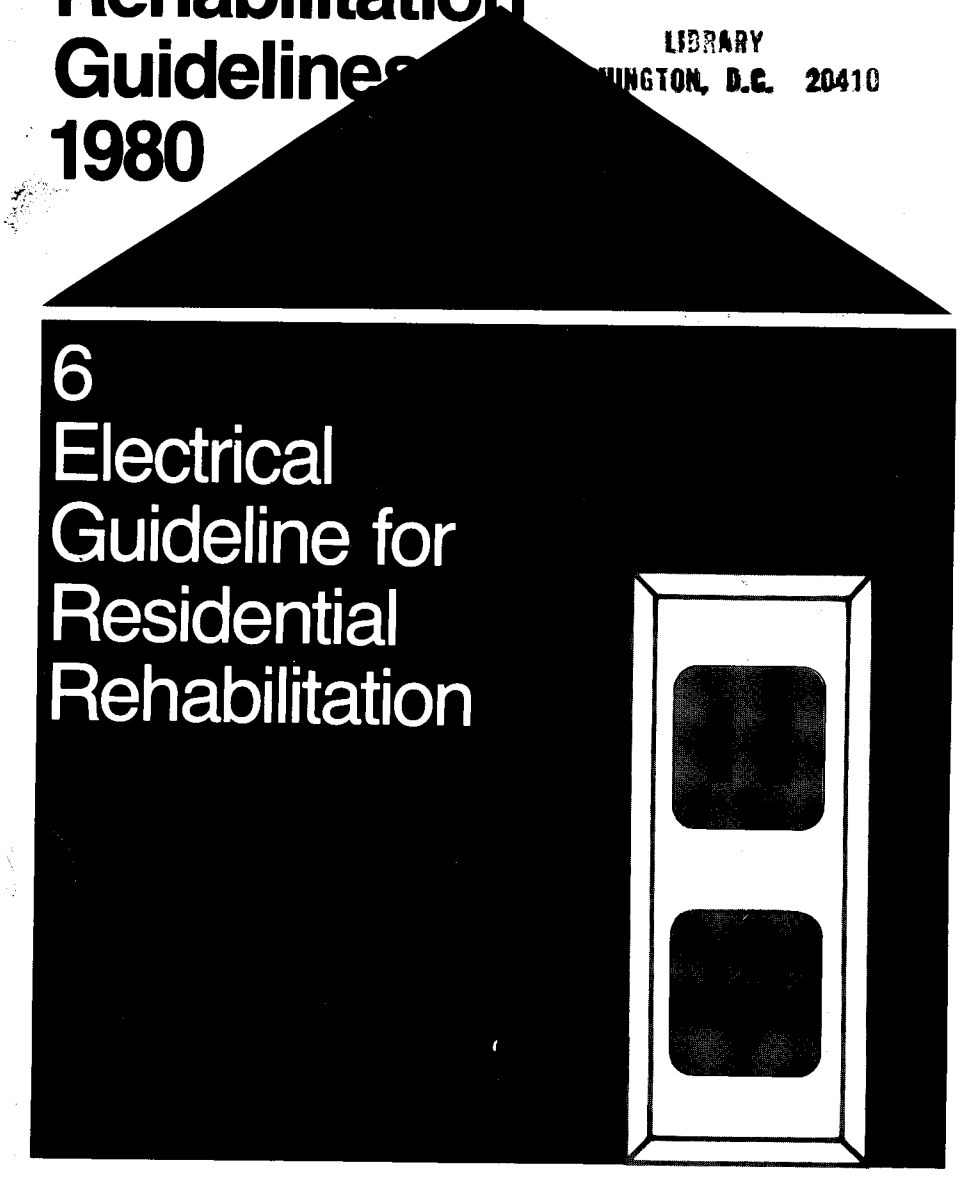

6 Electrical Guideline for Residential Rehabilitation

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- U.S. Conference of Mayors
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THE SECRETARY OF HOUSING AND URBAN DEVELOPMENT
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A congressional mandate--to develop model rehabilitation guidelines--led the U. S. Department of Housing and Urban Development to publish this and seven other guidelines that should help local policymakers, code officials, citizens' groups, architects, and engineers to deal with the conflicts that arise when codes, developed for new construction, are applied to old buildings undergoing rehabilitation.

This guideline concerns itself with a particularly complicated subject: electrical installations in residential buildings. It recommends establishing standards, discusses inspection, and concludes with sample problems and their solutions.

The guideline is thoughtful and direct, and often its solutions are so crisply stated that they hardly seem the product of a government agency. Following a list of sixteen separate electrical system hazards, it says, "Have all such conditions corrected." Yes!

The guideline is intended to facilitate rehabilitation by permitting the maximum re-use of existing facilities. It is not a code, but a guide for those who are empowered to interpret the code, grant exceptions to it, or waive portions of it. It should prove itself to be invaluable.

The quality of this guideline and the seven others in the series is the result of the untiring efforts of Robert Kapsch, program manager for HUD's Office of Policy Development and Research; William Brenner, project manager for the National Institute of Building Sciences; and David Hattis, consultant from Building Technology, Inc.

Moon Landrieu

Moon Landrieu
Secretary

The Rehabilitation Guideline Series

The *Rehabilitation Guidelines* were prepared by the National Institute of Building Sciences for the Department of Housing and Urban Development in response to the requirements of Section 903 of the Housing and Community Development Amendments of 1978.

As Congress intended, the *Rehabilitation Guidelines* are not a code, nor are they written in code language. Rather, they are designed for voluntary adoption and use by States and communities as a means to upgrade and preserve the nation's building stock, while maintaining reasonable standards for health and safety. The term "rehabilitation", as used in the guidelines, includes any set of activities related to the general view of existing buildings as a resource to be conserved, rehabilitated, or reused.

This initial edition of the *Rehabilitation Guidelines* is published in eight separate volumes. The first four guidelines are designed for use by building officials, members of the executive and legislative branches of government, and related commissions and organizations involved in developing or implementing building regulations. These guidelines cover the following topics:

1 The *Guideline for Setting and Adopting Standards for Building Rehabilitation* provides an introduction and background to the building regulations that affect rehabilitation. It describes methods for identifying regulatory problems in a community, and recommends ways to amend, modify, or supplement existing regulations to encourage rehabilitation.

2 The *Guideline for Municipal Approval of Building Rehabilitation* examines the inherent differences between regulating new construction and regulating rehabilitation, and presents specific recommendations for dealing with rehabilitation within municipal building departments.

3 The *Statutory Guideline for Building Rehabilitation* contains enabling legislation that can be directly adopted by communities to provide the legal basis for promoting rehabilitation through more effective regulation.

4 The *Guideline for Managing Official Liability Associated with Building Rehabilitation* addresses the liability of code officials

(i) **Stairwells:** Stairwells shall be adequately illuminated. Lighting outlets shall be controlled by wall switches. Wall switches shall be located for convenient and readily accessible use. Switches shall not be located where it is necessary to use darkened stair sections for their operation. All stairwells to finished portions of dwelling shall be provided with multiple switch control, one at the head the other at the foot of the stairwell.

(j) **Service and/or Feeder:** Service to existing dwelling unit shall be a minimum of one hundred ampere, three wire capacity, service equipment shall be dead front having no live parts exposed whereby accidental contact could be made. Type "S" fuses shall be installed when fused equipment is used.

Exception: Existing service of fifty-five ampere three wire capacity, and feeders of thirty ampere or larger two or three wire capacity shall be accepted if adequate for the electrical load being served.

(k) **Existing Wiring and Equipment:** Existing wiring and equipment shall be in good repair. Circuit extensions made with flexible cord wiring in lieu of permanent wiring shall be eliminated.

1000-2. **New Work.** All new work shall conform to this ordinance.

1000-3. **Evidence of inadequacy.** Evidence of inadequacy shall be any of the following:

(a) Use of cords in lieu of permanent wiring.

(b) Oversizing of overcurrent protection for circuits, feeders or service.

(c) Illegal extensions to the wiring system in order to provide light, heat or power.

(d) Electrical overload.

(d) Misuse of electrical equipment.

(f) Lack of lighting fixtures in bathroom, laundry room, furnace room, stairway or basement.

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involved with the administration and enforcement of rehabilitation, and provides recommendations for minimizing liability problems.

The remaining four guidelines are technical in nature, and are intended for use by code officials, inspectors, designers, and builders. They cover the following topics:

5 The *Egress Guideline for Residential Rehabilitation* lists design alternatives for the components of egress that are regulated by current codes such as number and arrangement of exits, corridors, and stairs, travel distance, dead-end travel, and exit capacity and width.

6 The *Electrical Guideline for Residential Rehabilitation* outlines procedures for conducting inspections of electrical systems in existing buildings, and presents solutions to common problems associated with electrical rehabilitation such as eliminating hazardous conditions, grounding, undersized service, number of receptacle outlets, and incompatible materials.

7 The *Plumbing DWV Guideline for Residential Rehabilitation* presents criteria and methods for inspecting and testing existing drain, waste, and vent (DWV) systems, relocating fixtures, adding new fixtures to existing DWV systems, extending existing DWV systems, and installing new DWV systems in existing buildings.

8 The *Guideline on Fire Ratings of Archaic Materials and Assemblies* contains the fire ratings of building materials and assemblies that are no longer listed in current building codes or related reference standards. Introductory material discusses flame spread, the effects of penetrations, and methods for determining the ratings of assemblies not listed in the guideline.

Single editions of the *Rehabilitation Guidelines*--or copies of specific guidelines--are available at no charge, as long as supplies last, from HUD USER, P.O. Box 280, Germantown, Maryland 20767. Phone (301) 251-5154

The *Rehabilitation Guidelines* are also available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Appendix
Detroit Electrical Code, Chapter 10

Appendix 1—Detroit Electrical Code, Chapter 10

Chapter 10 of the code is added as follows:

1000–1. Minimum standards for existing dwelling units.

If inspection reveals that the wiring system of an existing dwelling type occupancy is inadequate, or if code certification as a habitable dwelling under this section is requested, the following minimum requirements shall be complied with:

(a) **Entrances and Exits:** Where two (2) or more entrances and/or exits exist, at least two (2) entrances and/or exits shall be illuminated by exterior lights. Lighting outlets shall be controlled by interior wall switches, located for convenient and readily accessible use.

(b) **Living Room:** Living room shall be provided with illumination. Lighting outlet shall be controlled by a wall switch, located for convenient and readily accessible use. One of the receptacle outlets controlled by a wall switch in lieu of ceiling lighting outlet is acceptable. Convenient duplex receptacle outlets shall be provided. Receptacle outlets shall be equally spaced around the room with at least one duplex receptacle outlet on each wall.

(c) **Kitchen:** Kitchen shall be provided with illumination. Lighting outlet shall be controlled by a wall switch located for convenient and readily accessible use.

A separate kitchen appliance circuit shall be provided, supplying a minimum of three (3) grounding type duplex receptacle outlets. Two (2) of these receptacles shall be readily accessible for convenient use of portable appliances. New appliance circuits shall be twenty ampere capacity.

(d) **Bathroom:** Bathrooms shall be illuminated. Lighting outlet shall be controlled by a wall switch. A receptacle outlet separate from the light fixtures, shall be provided and shall be located at least thirty (30) and not more than forty-eight (48) inches above the floor adjacent to the wash basin and not more than four (4) feet from the basin.

(e) **All Other Habitable Rooms:** Illumination for each habitable room shall be provided. Lighting outlet shall be controlled by a wall switch. Wall switches shall be located for convenient and readily accessible use. Convenience duplex receptacle outlets shall be provided with a minimum of two (2) receptacle outlets equally spaced around the room. An additional receptacle outlet controlled by a wall switch is acceptable in lieu of a lighting outlet.

(f) **Basement:** Basement shall be wired for a minimum of one lighting outlet in each 200 square feet or major fraction of area for use as general illumination. All enclosed areas that may be walked into, such as toilet rooms, fruit storage rooms, utility rooms, excavated areas under porches, etc., shall be provided with at least one lighting outlet (except coal bins).

Stairwell and laundry area lighting outlets shall not be counted as part of the required basement lighting outlets.

(g) **Laundry Areas:** Laundry areas shall be provided with illumination. Laundry circuit shall be an individual circuit. A wall-mounted grounding type duplex receptacle outlet shall be provided, located near the laundry equipment.

An existing drop cord receptacle outlet on a separate circuit shall be acceptable providing it is a grounding type receptacle outlet not more than five (5) feet six (6) inches above the floor.

(h) **Space Heating System:** Heating equipment requiring electrical energy for operation and/or control shall be provided with an individual circuit. A disconnect switch shall be provided on or adjacent to the heating equipment (exception: thermo-pile controlled furnaces).

3.9
Access to Electrical Equipment

Problem: The configuration of access space to, and working space around, electric equipment to permit ready and safe operation and maintenance of the equipment is different from that required by the current code, such as NEC Section 110-16.

Solution: Permit such existing space to remain when the intent of the current code can be met.

Discussion: Equipment accessibility and working space are essential to safety. The existing space could be permitted to remain unchanged if it meets the requirements of the code under which it was constructed, additional equipment and/or new equipment of a higher service rating is not to be installed, and the installation has a history of safe operation, maintenance, and repair.

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Acknowledgments

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Overall management and production of the *Rehabilitation Guidelines* was directed by William Brenner of the Institute, with David Hattis of Building Technology, Inc. the principal technical consultant. Guideline cover graphics and layouts were designed by the Design Communication Collaborative.

3.7
Extending General Purpose Ungrounded Branch Circuits

Problem: An existing general purpose branch circuit that is to be extended conforms to the current code, but doesn't have an equipment grounding means.

Solution: Permit ungrounded, nonconforming, general purpose branch circuits to be extended to all locations except kitchens, baths, basements, garages, and locations within reach of grounded surfaces.

Discussion: Kitchens, baths, basements, garages, and locations within reach of grounded surfaces represent a particular hazard as compared to other locations. This hazard is reduced by equipment grounding means installed according to the current code or this guideline.

3.8
Number of Receptacle Outlets

Problem: The number of existing receptacle outlets is less than required by the current code.

Solution: Permit fewer receptacle outlets than required by the current code.

Discussion: The number and location of receptacle outlets required for the safe and convenient use (as this bears on safety) of rooms and spaces varies and can best be determined by the judgment of communities and jurisdictions individually. Such factors as number of occupants, floor area, room configuration, and window and door locations all affect the number and location of receptacle outlets which meets the intent of the current code. Examples of such reductions in the number of required receptacle outlets are contained in the BOCA Basic Property Maintenance Code, Section H-602.0, ELECTRICAL FACILITIES (see Part 1 above) and the Detroit Electrical Code, Chapter 10 (see Appendix).

cooking, heating, and domestic hot water. Determining existing loads and new loads planned as a part of rehabilitation requires judgment. If there is any indication that loads will increase in the future, this should be taken into consideration. Using the actual installed load is a means to control otherwise unnecessary rehabilitation, while maintaining the standards of safety required by the current code.

3.6
Second Service Entrance and Disconnect

Problem: In one- and two-family dwellings, the existing service rating is to be increased by the addition of a second service entrance and a second service disconnect in order to meet the current code or this guideline, but space is limited or there are other, similar constraints.

Solution: Add the second service entrance and the second service disconnect at a location different from the existing service disconnect, provided:

- Both disconnects meet the current code, such as NEC Section 230-44 and 230-72(a) and (c);
- Permanent warning signs are erected at each location indicating separate service disconnects; and
- The combined rating of the separate service disconnects is not less than that required by the current code or recommended by other sections of this guideline for a single service disconnect.

Discussion: These recommendations are intended to eliminate the potential hazard of installing a single, new, service entrance in an inappropriate location, and are a means to control otherwise unnecessary rehabilitation. Any hazard associated with a "split" service is also eliminated by the suggested provisions of the recommendations and the restriction of split service to residences of no more than two families. A split service installed as recommended is an alternative to the current code which may provide an equivalent level of safety.

Introduction

This guideline addresses only those select problem areas most identified with rehabilitation projects. The guideline is not a code, but like an electrical code, it is intended for use by persons knowledgeable about electrical design and installations. The guideline addresses three major subject areas:

- Setting and adopting electrical rehabilitation standards at the state or local level;
- Inspecting existing electrical installations; and
- Problems and solutions for hazardous conditions, inadequate load-carrying capacity, and additions, alterations and extensions to existing electrical installations.

With regard to the problems and solutions, this guideline applies to all types of residential occupancies except hotels, rooming houses, dormitories, and housing for the elderly. It is intended to facilitate the maximal re-use of existing electrical installations in circumstances where, for some reason, code requirements for new construction are being applied to a project undergoing rehabilitation. In general, there are two such circumstances:

- Repair and improvement of existing residential buildings when compliance with the code requirements for new construction is triggered by a 25-50% Rule or similar rule which is in effect in the jurisdiction.
- Change of use or occupancy into a residential occupancy (e.g., from one- and two-family dwelling to apartment building, from hotel to apartment building) when compliance with the code requirements for new construction is triggered by the provisions of the code in effect or some other provision.

For rehabilitation involving a change of use or occupancy, this guideline should be used when it is feasible to reuse some portion of an existing electrical installation.

It has been long recognized that electrical codes pose special problems for rehabilitation projects. Some communities have adopted special electrical codes to be used for rehabilitation. One example, the City of Detroit's electrical code for reha-

bilitation, is shown as an Appendix to this guideline. Some of the model electrical codes give the code enforcement authority the responsibility for making interpretations of the rules, for granting exceptions to the rules, and for waiving specific requirements of the code. The following sections of the 1978 Edition of the National Electric Code (hereinafter NEC) illustrate this "flexible" approach:

"Section 90-2.(c) Special Permission. The authority having jurisdiction for enforcing this Code may grant exception for the installation of conductors and equipment, not under the exclusive control of the electric utilities and used to connect the electric utility supply system to the service entrance conductors of the premises served, provided such installations are outside a building or terminate immediately inside a building wall."

"Section 90-4. Enforcement. This Code is intended to be suitable for mandatory application by governmental bodies exercising legal jurisdiction over electrical installations and for use by insurance inspectors. The authority having jurisdiction of enforcement of the Code will have the responsibility for making interpretations of the rules, for deciding upon the approval of equipment and materials, and for granting the special permission contemplated in a number of the rules."

"Section 90-5. Formal Interpretations. To promote uniformity of interpretation and application of the provisions of this Code, the National Electrical Code Committee has established interpretation procedures."

1
Establishing Standards for Electrical Rehabilitation

A community using this guideline may also have a need to set standards for rehabilitating electrical installations. A general process for establishing local standards is discussed in detail in the *Guideline for Setting and Adopting Standards for Building Rehabilitation.*

There are a number of other sources of information besides this guideline that a community may use to establish suitable requirements and criteria for electrical rehabilitation. Current electrical codes, such as the NEC, are one such source of rehabilitation

- No receptacle outlet or fixture is located where it will be in reach of grounded surfaces.

Discussion: An existing general purpose branch circuit or feeder without an equipment ground which is inspected, found to be still in acceptable physical and functional condition, and is not overloaded can be considered to have a history of operating safely. Therefore, its safe operation can be expected to continue, and it may be allowed to remain. It is important that such a circuit does not serve as an applicance branch circuit; that load calculations consider both existing loads not affected by rehabilitation and new loads which are a result of rehabilitation; and that the receptacle outlets and fixtures on such a circuit are safely located out of reach of grounded surfaces.

3.5
Undersized Service

Problem: The size of the service is inadequate for the load as calculated according to the current code.

Solution: Recalculate the size of the service for the actual connected (installed) load and the loads for circuits calculated according to the current code, provided:

- The service disconnecting means has a rating not less than the actual connected load;
- Loads established for branch circuits and feeders are determined with the diversities and calculation methods defined in the current code; and
- All other aspects of the service meet the current code, such as NEC Tables 310-16 to 19 including the notes to these Tables, Article 210, Article 220, Article 240 and Article 230 except Section 230-79(c) for single-family dwellings and Section 230-79(d) for all other occupancies.

Discussion: In determining the actual connected load, include both existing loads not affected by rehabilitation and new loads which are planned as a part of rehabilitation. The probability of the use of room air conditioners should also be considered. The use of energy sources other than electricity can reduce the load. Therefore, consider the use of other energy sources for

Solution: Permit ungrounded, nonconforming, existing fixed appliance branch circuits to remain, provided:

- Alternative grounding is provided for appliances by the connection of an equipment grounding conductor to a grounded, metallic, cold water pipe;
- Service equipment, service raceways, service grounded conductors, switchboards, and panelboards are grounded in accordance with the current code, such as NEC Article 250, or alternative grounding is provided by the connection of an equipment grounding conductor to a grounded, metallic, cold water pipe;
- Branch circuit equipment grounding conductors are in accordance with the current code, such as NEC Article 250; and
- Ungrounded, nonconforming, existing, general purpose branch circuits conform to Part 3.4 of this guideline.

Discussion: This alternative method of grounding existing fixed appliance branch circuits is not the method usually required by code, but it will provide an equivalent level of safety. And, since this alternative method is relatively simple to install, it is an aid to rehabilitation. But, it's important to make sure in such installations that equipment grounding conductors are connected to *cold* water pipes which are *metal* and which are *grounded.*

3.4
Grounding of General Purpose Branch Circuits or Feeders

Problem: An existing general purpose branch circuit or feeder is without an equipment grounding means which is contrary to the current code.

Solution: Allow ungrounded, nonconforming, existing, general purpose branch circuits, or feeders to remain, provided that:

- No circuit or feeder is overloaded when the load-carrying capacity is calculated as in Part 2.3 of this guideline;
- No general purpose branch circuit serves loads required by the current code to be served by small appliance branch circuits; and

standards information. Although these codes principally regulate new construction, and therefore may not adequately address the problems of rehabilitating existing buildings, certain new construction provisions may still be applicable. For example, provisions regulating grounding, feeders, and service ratings can be adopted as electrical rehabilitation standards when a community wishes to maintain a level of performance in rehabilitated buildings equivalent to that for new construction.

In addition, the "alternative materials and methods" provision in new construction codes provides a means by which acceptable solutions to electrical rehabilitation problems can be developed that are different from those prescribed by the current code.

Property maintenance codes, fire prevention codes, and hazard abatement codes could be another basis for setting electrical rehabilitation standards. Though these codes do not contain precise enough information to be useful in setting specific standards, they can still provide a general basis for establishing both a minimum level of performance and a level of performance less than that required by new construction codes.

For example, the BOCA Basic Property Maintenance Code states in Section H-602.0, ELECTRICAL FACILITIES:

"H-602.1 Outlets required: Where there is electric service available to a structure, every habitable room of a dwelling unit, and every guest room, shall contain at least two (2) separate and remote outlets, one (1) of which may be a ceiling or wall-type electric light fixture. In a kitchen three (3) separate and remote wall-type electric convenience outlets or two (2) such convenience outlets and one (1) ceiling or wall-type electric light fixture shall be provided. Every public hall, water closet compartment, bathroom, laundry room or furnace room shall contain at least one (1) electric light fixture. In addition to the electric light fixture in every bathroom and laundry room, there shall be provided at least one (1) electric outlet.

"H-602.2 Installation: All electrical equipment, wiring, and appliances shall be installed and maintained in a safe manner in accordance with all applicable laws. All electrical equipment shall be of an approved type.

"H-602.3 Defective system: Where it is found, in the opinion of the building official, that the electrical system in a structure constitutes a hazard to the occupants or the structure by reason of inadequate service, improper fusing, insufficient outlets, improper wiring or installation, deterioration or damage, or for similar reasons, he shall require the defects to be corrected to eliminate the hazard."

Similarly, the BOCA Basic Fire Prevention Code states in SECTION F-105.0, ORDERS TO ELIMINATE DANGEROUS OR HAZARDOUS CONDITIONS, F-105.1 General:

"Whenever the fire official or his designated representative shall find in any structure or upon any premises dangerous or hazardous conditions or materials as follows, he shall order such dangerous conditions or materials to be removed or remedied in accordance with the provisions of this code: . . . 7. hazardous conditions arising from defective or improperly used or installed electrical wiring, equipment or appliances"

Past electrical codes for new construction are an especially important source of information for setting electrical rehabilitation standards. The performance levels required by past electrical codes are different from, and may be lower than, the current electrical codes. Past codes, however, are most useful in determining after an on-site inspection whether an existing building currently meets the code under which it was built.

Finally, laws and regulations affecting electrical installations which apply retroactively to existing buildings are by definition mandatory standards for electrical rehabilitation.

2 Inspection

An inspection of the existing electrical installation may be necessary to provide the authority having jurisdiction with the information needed to evaluate a proposed electrical rehabilitation project (see the *Guideline for Approval of Building Rehabilitation*). Inspections are also an essential part of enforcing property maintenance, fire prevention, and hazard abatement codes.

The use of flexible cord as a permanent wiring method may indicate the need for more receptacle outlets (see Part 3.8 below).

3.2 Incompatible Conductors, Devices, and Equipment

Problem: Circuit breaker, fuse, switch, receptacle, other device, fixed utilization equipment, raceway, connector, terminal, splicing device, or other fitting is not compatible with the type of conductor used, or the electrical connection does not meet the current code, such as NEC Section 110-14.

Solution: Have all such connections of conductors to terminal parts, conductor splices, or conductors joined with splicing devices corrected to meet the current code, such as NEC Section 110-14(a) and 110-14(b), and have all incompatible conductors, devices, or equipment corrected to meet the current code, such as NEC Section 110-14, by:

- Replacing existing conductors with new conductors which are compatible with the existing devices or equipment; or
- Replacing existing devices or equipment with new devices or equipment which are compatible with the existing conductors; or
- Installing an insulated conductor "pigtail" compatible with the existing device or equipment.

Discussion: Improper connections and splices, and incompatible conductors, devices, and equipment can be hazardous. There are problems associated with defective or improperly installed wiring or equipment. These conditions, depending upon the number and severity of the problems, may be judged an imminent hazard by an authority having jurisdiction. If that is the case, the hazard must be corrected immediately or the installation disconnected.

3.3 Grounding of Fixed Appliance Branch Circuits

Problem: An existing fixed appliance branch circuit does not have an equipment grounding means which is required by the current code.

- Receptacle contact devices are not firmly in contact with the contact devices of a standard type flexible cord attachment plug when the plug is inserted in the receptacle;
- Bathroom receptacle, garage receptacle, or outdoor receptacle with direct grade level access is without ground fault circuit interruptor protection;
- Neutral is not grounded at the main service entrance equipment location by a properly connected grounding electrode conductor;
- Polarity is reversed in wiring connections to receptacle outlets;
- Fixed utilization equipment, such as a lighting fixture, lampholder, or appliance, operates intermittently;
- Building construction adjacent to wiring, equipment, or appliance is burnt;
- Service, feeder, or branch circuit conductors have evidence of intermittent operation, impaired operation, or cannot otherwise be determined as acceptable when the installation is energized;
- Flexible cord is used as a permanent wiring method;
- Branch circuit, feeder, switchboard, panelboard, or distribution board service rating is inadequate for the load calculated in accordance with the current code; or
- Pull-chain switch or brass shell socket in a wet or damp location is within reach.

Solution: Have all such conditions corrected.

Discussion: These conditions are hazards of varying degree. They are problems associated with defective or improperly used or improperly installed wiring, equipment, or appliances. If any one or combination of these conditions is extensive, severe, or occurs frequently in an installation, an authority having jurisdiction may judge that an imminent hazard exists. In that case, the hazard must be corrected immediately or the installation disconnected.

This part of the guideline outlines a procedure for conducting inspections of existing electrical installations to determine their physical condition, functional condition, and load-carrying capacity.

Electrical construction drawings and/or specifications of an existing building do not represent the present physical and functional condition of the electrical installation; these conditions can only be determined from an on-site inspection. However, if it is determined that electrical construction drawings accurately and completely represent the present electrical installation in an existing building, they could be used in conjunction with the current electrical code to calculate the installation's load-carrying capacity.

It is recommended that inspections be made by qualified electrical personnel, as determined by each jurisdiction.

Step 1
Physical Condition

Determine the physical condition of the existing electrical installation, including individual dwelling units and common areas of multi-family dwellings. Inspect the physical condition of the parts of the installation which are normally exposed to view.

Next, turn off the power to the individual dwelling units and common areas of multi-family dwellings, and remove the covers and open the doors of switchboards, panelboards, cabinets, and boxes. Inspect the physical condition of the exposed, internal components and wiring, as well as the surrounding building construction.

If the condition of the conductor insulation cannot be determined by inspection, perform an insulation resistance test. Similarly, if the condition of receptacles cannot be determined by inspection, test them by inserting a standard type flexible cord attachment plug.

Detach fixed utilization equipment such as lighting fixtures, lampholders, and appliances (e.g., built-in electrical space heaters) to inspect the physical condition of their exposed, internal components and wiring, as well as the surrounding building construction. In older buildings, however, detachment may contribute to, or actually cause, defects in equipment, appliances, or wiring.

Therefore, consider detaching fixed utilization equipment only when:

- Such wiring, equipment or appliance is part of a rehabilitation plan;
- Problems are evident from the first inspection of parts which are normally exposed to view; or
- Problems of function are evident from inspection or records, or are identified by owners or tenants.

Step 2
Functional Condition

If the physical condition of the installation seems safe, determine the functional condition with the power on in individual dwelling units and in common areas of multi-family dwellings. Inspecting an installation with the power on is essential to determining its condition.

When a building or dwelling unit is without power because it is unoccupied or an imminent hazard exists, determining functional condition may have to be delayed until rehabilitation has begun, or an exploratory permit may have to be secured by the building owner from an authority having jurisdiction to turn the power on.

Remove the covers and open the doors on equipment to expose circuit breakers, switches, receptacles and other devices, and conductor splices and connections; then:

- Operate circuit breakers, switches, other operable devices and fixed utilization equipment;
- Observe the function of operable devices; and
- Observe the operation and assess the operating temperatures of fixed utilization equipment.

Make inspections to determine the physical and functional conditions of existing electrical installations in accordance with the current code, such as NEC Section 110-3(a). Whenever possible, as an aid in assessing an installation's condition, secure information from owners, tenants, or from the records of all possible

authorities having jurisdiction (e.g., health departments, licensing bureaus) about past operating problems that cannot be found easily by inspection, such as the frequency of fuses blowing or short circuits.

Step 3
Load-Carrying Capacity

Determine the load carrying capacity of the existing electrical installation by calculation in accordance with the current code.

3
Problems and Solutions

3.1
Hazardous Conditions

Problem: The existing electrical installation has any one or combination of the following conditions which are contrary to the intent of property maintenance, fire prevention, and hazard abatement codes:

- Equipment or wiring is missing, broken, disconnected, loosely connected, unsupported, not securely fastened in place, corroded, burnt, cracked, split, has evidence of overheating, physical damage, or misuse;
- Equipment is dirty or contains debris;
- Wiring is frayed;
- Labeled or listed equipment or wiring is not installed in accordance with any labeling or listing instructions;
- Circuit breaker, fuse, switch, receptacle, other device, fixed utilization equipment, or wiring is not compatible with the phase, voltage, amperage, or type characteristics of the electricity in use;
- Circuit breaker, switch, or other operable device has visible evidence of arcing or overheating;