DISCUSSION OF BUILDING CODES AND STANDARDS APPLICABLE TO ROOFING IN THE UNITED STATES

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KEYWORDS

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ABSTRACT

In the United States, four model building codes currently provide the technical basis for building construction. These codes provide the minimum legal requirements for construction, including the design, manufacture and installation of roof assemblies.

As late as the mid 1980s, these building codes were relatively silent on specific requirements applicable to roofs. However, following several large national disasters that caused considerable property damage in the late 1980s and early 1990s, building officials, property insurers and the general public have taken significant steps in making these codes more stringent, particularly as they relate to roofing.

This paper provides detailed information regarding current model building code requirements applicable to roofs, including information on industry standards incorporated within the codes. Regional and local adoption of specific codes will also be discussed.

This paper will be useful to roofing professionals who may not be familiar with the minimum requirements for roof assemblies in the United States. This information will be particularly useful to individuals or companies considering introducing roofing products or services in the United States.

RÉSUMÉ

Aux Etats-Unis, il existe actuellement quatre codes qui fournissent les bases techniques pour la construction des bâtiments. Ces codes contiennent les exigences minimum légales requises pour la construction, y compris le design, la fabrication et l'assemblage des toits.

Jusqu'au milieu des années 1980, ces codes de construction sont restés relativement vagues quant aux normes spécifiques à respecter pour les toits. Cependant, à la suite de plusieurs catastrophes d'ampleur nationale, ayant causé des dégâts matériels considérables à la fin des années 1980 et au début des années 1990, les professionnels de la construction, les assureurs et le grand public ont pris des mesures importantes : ces codes sont désormais plus rigoureux, en particulier lorsqu´ils concernent la toiture.

Cet exposé fournit des renseignements détaillés en ce qui concerne les exigences actuelles du code de construction pour les toits. Ces codes contiennent aussi des renseignements sur les normes actuellement en vigueur dans l'industrie. La question de l'adoption de codes spécifiques au niveau régional et local sera également discutée.

Cet exposé sera donc utile aux professionnels de la toiture qui ne connaissent peut-être pas les exigences minimum requises pour la construction des toits aux Etats-Unis. Par ailleurs, les renseignements fournis seront également utiles aux particuliers et aux entreprises qui envisagent d'introduire les produits ou les services de la toiture aux Etats-Unis.

ZUSAMMENFASSUNG

In den Vereinigten Staaten versehen gegenwärtig vier Modell-Gebäude Verschlüsselungen die Konstruktion von Gebäuden auf technischer Basis. Diese Codierungen stellen die minimum gesetzlichen Bestimmungen der Konstruktion dar, einschließlich des Designs, Herstellung und die Installation von Dach-Versammlungen.

Bis Mitte der 80ziger Jahre waren diese Gebäude Codierungen sehr ruhig auf dem Gebiet für gezielte Anforderungen der Dach

Konstruktion. Doch nach mehreren größeren nationalen Katastrophen, die beträchtliche Gebäude Schäden in den späten 80zigern und frühen 90zigern Jahren verursachten, haben Gebäude Beamte,Versicherungsagenten und die allgemeine Öffentlichkeit bedeutungsvolle Schritte gemacht um diese Codierungen strenger zu machen, insbesondere, da sie sich auf Verdachen beziehen.

Dieses Papier stellt ausführliche Informationen hinsichtlich aktueller Modell Gebäude Code Anforderungen anwendbar für Dächer, einschließlich Informationen auf Industrie-Standards, die innerhalb der Codes integriert werden, bereit. Regionale und örtliche Adoption bestimmter Codierungen wird auch diskutiert werden.

Dieses Papier wird eine Hilfestellung für Fachkräfte von Dach Verdeckungen sein, die vielleicht nicht mit den Minimum-Anforderungen für Dach-Montage in den Vereinigten Staaten vertraut sind. Diese Informationen werden Individuelen oder Gesellschaften in Anbetracht der Einführung von Produkte oder Dienstleistungen für das Dach Gewerbe in den Vereinigten Staaten sehr nützlich sein.

RIASSUNTO

Negli Stati Uniti, quattro regolamenti edilizi tipo offrono attualmente la base tecnica per l'industria edilizia. Questi regolamenti stabiliscono I requisiti legal minimi per l'edilizia, incluso il design, la fabbricazione e l'installazione delle coperture.

Non piu tardi degli anni '80, questi regolamenti non avevano molto a che fare con i requisiti specifici alle coperture. Tuttavia, in seguito a numerosi grossi disastri nazionali che causarono considerevoli danni alle proprieta verso la fine degli anni i 80 e gli inizi dei '90, gli ufficiali edili, gli assicuratori delle proprieta ed il pubblico generale presero dei provvedimenti importanti per rendere questi regolamenti piu rigorosi, particolarmente per quanto riguardava le coperture.

Questa relazione offre informazioni dettagliate sui requisiti degli attuali regolamenti edilizi tipo applicabili alle coperture, ed include informazioni sugli standard dell'industria che sono incorporati nei regolamenti. Essa tratta inoltre l'adozione regionale e locale dei regolamenti specifici.

La relazione sara utile ai professionisti del settore delle coperture, che non conoscono i requisiti minimi per l'installazione delle coperture negli Stati Uniti. Queste informazioni saranno di particolare interesse agli individui od alle aziende che stanno pensando d'introdurre i loro prodotti o servizi per le coperture negli Stati Uniti.

AUTHOR

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INTRODUCTION

In the United States, the history of building codes dates back to the earliest settlers of the first American colonies, who brought with them a number of building safety regulations from Europe. These early regulations, which were incorporated into municipal laws, addressed such things as the spacing between houses, basic sanitation requirements, construction and maintenance of fireplaces and chimneys, and materials used in roof coverings [1].

When the Constitution of the United States was written, state governments retained their authority to adopt and enforce regulations assuring the health and safety of citizens. Some states have further delegated such authority to local government (e.g., county, parish, city, town).

In the early 1900s, major insurance companies encouraged the development of "model codes" which were intended to help reduce both the number of fatalities and amount of property loss payments of claims for fire-related losses. Many major U.S. cities, including New York, Baltimore, Boston, Philadelphia, Chicago, New Orleans and San Francisco, began incorporating provisions from insurance company-generated model codes into their own building health and life safety requirements.

Also in the early 1900s, Wisconsin and North Carolina became the first U.S. states to adopt state-wide regulations governing the public's health and life safety of buildings. Because of their more complex structure, size and occupancy, hotels, office buildings, theaters, storage facilities, factories and large apartment buildings were the types of building structures regulated by these first state codes.

With the post-World War II housing boom in the U.S., the introduction of new building materials, including new roofing materials, and innovative design and construction techniques contributed significantly to the scope and number of technical provisions added to building codes.

With the increases in states' regulations governing the public's health and the life safety of buildings, and increases in the types and number of building materials and systems, it became apparent that there was a need for uniformity in building regulations. This spawned the development of "model building codes" in the U.S.

Model Building Codes

Currently there are four major model code groups which have developed and maintain model building codes in the U.S. These groups are the Building Officials and Code Administrators International, Inc.; International Conference of Building Officials; Southern Building Code Congress International, Inc. and International Code Council. Contact information for each of these model code groups is provided in Appendix 1.

A brief description of each of the major U.S. model code groups is as follows.

Building Officials and Code Administrators International, Inc.

The Building Officials and Code Administrators International, Inc., commonly referred to as "BOCA", was established in 1915 as an independent, not-for-profit association of code enforcement officials, industry and design professionals, and other interested parties and organizations. BOCA currently has a membership of more than 16,000 individuals.

BOCA published their first model building code in 1930 [1]. Revised editions of this code have been published on approximate three-year intervals; to date fourteen editions of BOCA's model building code have been published. The current edition of BOCA's model building code is titled *The BOCA National Building Code/1999* (BNBC/99). BNBC/99 presents BOCA's code as originally issued, with changes approved through 1999, and with certain editorial changes made to maintain the sequence of the code and update the references to standards.

BNBC/99 compliments other model codes published by BOCA including *The BOCA National Fire Prevention Code*, *The BOCA National Mechanical Code*, *The BOCA National Plumbing Code* and *The BOCA National Property Maintenance Code.*

BOCA has suspended development of their own model codes in support of the model codes developed and maintained by the International Code Council. At this point, further development of updated editions of BOCA's model codes is not anticipated.

International Conference of Building Officials

The International Conference of Building Officials, commonly referred to as "ICBO", was established in 1922 as an independent, not-for-profit group of code enforcement officials, as well as other interested parties and organizations.

ICBO published their first code in 1927 [1]. Revised editions of this code have been published at approximate three-year intervals. New editions incorporate changes approved by the ICBO membership since the previous edition was published. The current edition of ICBO's model building code is titled *1997 Uniform Building Code* (1997 UBC).

1997 UBC compliments ICBO's other model codes including the *Uniform Fire Code, Uniform Mechanical Code, Uniform Plumbing Code* and *Uniform Zoning Code*.

ICBO has suspended development of their own model codes in support of the model codes developed and maintained by the International Code Council. At this point, further development of updated editions of ICBO's codes is not anticipated.

Southern Building Code Congress International, Inc.

The Southern Building Code Congress International, Inc., commonly referred to as "SBCCI", was established in 1940 as an independent, not-for-profit group of organizations and individuals, including code officials, architects, engineers and industry representatives.

SBCCI published their first building code in 1940, the same year the organization was established. Revised editions have been published on approximate three-year intervals incorporating any changes approved by the SBCCI membership since the previous edition was published. The current edition of SBCCI's model building code is titled *1999 Standard Building Code* (1999 SBC).

1999 SBC compliments SBCCI's other model codes including the *Standard Fire Prevention Code, Standard Mechanical Code, Standard Plumbing Code* and *Standard Existing Buildings Code*.

SBCCI suspended further development of their own model codes in support the model codes developed and maintained by the International Code Council. At this point, development of future editions of SBCCI's model codes are not anticipated.

International Code Council

The International Code Council, commonly referred to as "ICC", was established in 1994 as a not-for-profit organization dedicated to developing and maintaining a single set of comprehensive coordinated, national, building-related model codes [2]. ICC's founders are the three major U.S. model building code groups: BOCA, ICBO and SBCCI.

In 2000, ICC published the first edition of their model building code, titled *2000 International Building Code* (2000 IBC). This is the current edition of ICC's model building code.

2000 IBC compliments ICC's other model codes, including the *International Zoning Code, International Fire Code, International Plumbing Code and International Mechanical Code.* Collectively, ICC's 11 model codes, which are commonly referred to as the "I-codes", provide a comprehensive, coordinated set of model codes for adoption throughout the U.S.

ICC's model codes are intended to eventually replace BOCA's, ICBO's and SBCCI's model codes [2, 3].

Model Code Applicability

BOCA, ICBO, SBCCI and ICC develop model codes for adoption by individual regional (e.g., state, county, parish) and municipal (e.g., city, town) governmental entities. These individual governments enact model codes into law by enacting ordinances. The model building codes groups themselves have no direct authority to adopt or enforce compliance with the model codes they write and maintain [4].

BNBC/99, 1997 UBC, 1999 SBC or earlier editions of these model building codes are applicable generally throughout the U.S., with exception to the states of New York and Wisconsin, which develop their own state codes [5].

In general, BNBC/99 or earlier editions of BOCA's model building code is applicable in the Northeast, Mid-Atlantic and portions of the Midwest regions of the U.S. [5, 6]

1997 UBC or earlier editions of ICBO's model building code is generally applicable in the western regions of the U.S. and the state of Indiana [6, 7].

1999 SBC or earlier editions of SBCCI's model building code is generally applicable in the south and southeast regions of the U.S. [6, 7]

Currently, 2000 IBC has not yet been adopted in any major code jurisdications. However, the adoption process is currently underway in a number of juridications and adoption in several juridication is likely in the near future.

In some instances, a local governmental entity may adopt a building code different from that which is common on the region. For example, while the BNBC/99 or earlier editions of BOCA's model building code is commonly adopted in Illinois, the city of Chicago (which is in the state of Illinois) develops and maintains their own building code, titled the *City of Chicago Building Code*.

The National Conference of States on Building Codes & Standards, Inc. (NCSBCS) publishes two directories detailing code applicability for states and various cities in the U.S. These directories are titled *Directory of Building Codes and Regulations—State Directory* and *Directory of Building Codes and Regulations—City Directory*. Contact information for NCSBCS is provided in Appendix 1.

Roofing-Related Code Requirements

Building codes are generally intended to safeguard the health, life, safety and welfare of building's occupants by regulating building construction, as well as the building components and materials used [1].

As it applies to roofing, the scope of 2000 IBC indicates the code's provisions "...shall govern the design, materials, construction and quality of roof assemblies and rooftop structures." The scopes of BNBC/99, 1997 UBC and 1999 SBC are similar.

BOCA/99, 1997 UBC, 1999 SBC and 2000 IBC utilize a "common code format," which means each code is formatted similarly and the chapter format of each code is similar. A majority of the roofing-related requirements in each of the codes is provided in Chapter 15, which is typically titled "Roof Assemblies and Rooftop Structures." However, some roofing-related information is also provided in other chapters of the codes. For example, requirements for ventilation of attic spaces are commonly provided in Chapter 12, "Interior Environments." Minimum requirements for thermal insulation used in roof

assemblies is commonly provided in Chapter 13, typically titled "Energy Conservation." Wind-load requirements for roof assemblies are commonly provided in Chapter 16, which is typically titled "Structural Loads." Below-grade waterproofing requirements are commonly found in Chapter 18, typically titled "Foundations." Requirements for plastic foam insulation (e.g., polyurethane, polystyrene, polyisocyanurate) are commonly found in Chapter 26, "Plastics."

In general, Chapter 15 of each of the codes addresses three primary attributes for roof assemblies: fire resistance, uplift resistance (i.e., resistance to wind) and compliance with applicable material standards. A discussion of each of these attributes is as follows.

Fire Resistance

Roof assemblies are expected to be resistant to a certain degree to fire on the exterior-side of the roof surface and, in some building occupancy types, from the interior-side of the roof assembly.

In order to address fire resistance on the exterior, roof assemblies are commonly categorized into classes: Class A, Class B and Class C. Class A provides the highest degree of fire resistance, Class B a moderate degree of fire resistance and Class C the least degree of fire resistance.

Fire resistance classifications are typically determined by either of two recognized test methods: American Society for Testing and Materials (ASTM) E108, "Standard Test Method for Fire Tests of Roof Coverings" and Underwriters Laboratories, Inc. (UL) 790, "Tests for Fire Resistance of Roof Covering Materials." 1997 UBC utilizes UBC Standard 15-2, "Tests Standard for Determining the Fire Retardancy for Roof Assemblies," which is similar to ASTM E108 and UL 790, to determine fire resistance classifications.

Certain roof assembly types, such as slate, clay (e.g., clay tile) and metal panels are assigned fire resistance classifications without testing based upon these materials' inherent resistance to fire. A discussion of these specific roof assembly types and other fire resistance requirements are provided in BNBC/99

Section 1506.0, 1997 UBC Section 1504.0, 1999 SBC Section 1505 and 2000 IBC Section 1505.

Roof assemblies resistance to fire on the interior-side is commonly addressed in Chapter 7, typically titled "Fire Resistance-Rated Construction," in each of the codes. Roof assemblies resistance to fire on the interior-side is typically determined by UL 1256, "Fire Test of Roof Deck Construction."

Uplift Resistance

Uplift resistance requirements for roof assemblies are provided in BNBC/99 Section 1505.0, 1999 SBC Section 1504 and 2000 IBC Section 1504. 1997 UBC's uplift requirements are provided in Chapter 16.

In general, in each of the model codes, roof assemblies are required to be resistant to the basic wind speed as defined in Chapter 16, adjusted for the building height above grade, building exposure wind gust effect and wind importance factor. Wind resistance for roof assemblies is typically determined by any of four test methods: Factory Mutual Research (FM) 4450, "Approval Standard for Class 1 Insulated Steel Deck Roofs;" FM 4470, "Approval Standard for Class 1 Roof Coverings;" UL 580, "Test for Uplift Resistance of Roof Covering Materials" and UL 1897, "Uplift Tests for Roof Covering Systems ."

In recent years the model codes have noticeably increased the wind uplift resistance requirements for roof assemblies, making these portions of the codes some of the most difficult for compliance [4, 5, 7].

Material Standards

The codes adopt and require compliance with nationally recognized material standards as the criteria for the evaluation of minimum safe practice and for determining the performance of materials and systems. Requirements for specific roofing materials to comply with recognized material standards are referenced throughout Chapter 15 of BOCA/99, 1997 UBC, 1999 SBC and 2000 IBC. A list of each of the codes' material standards requirements for specific roof assembly types is provided in Appendix 2.

In many instances, the material standards requirements for roofing materials provided in the codes are relatively stringent. For example, in the U.S. there are currently two recognized standards addressing glass fiber-reinforced asphalt shingles: ASTM D3018, "Standard Specification for Class A Asphalt Shingles Surfaced with Mineral Granules," and ASTM D3462, "Standard Specification for Asphalt Shingles Made from Glass Felt and Surfaced with Mineral Granules." ASTM D3462 is generally considered the more stringent of these two standards [8]. BOCA/99, 1999 SBC and 2000 IBC require glass fiber-reinforced asphalt shingles to comply with ASTM D3462 and do not specifically allow compliance solely with ASTM D3018.

Alternate Materials and Systems

By the nature in which model codes are written, they tend to somewhat limit the number of designs, materials and systems that can be utilized in buildings. However, the provisions of the model codes are not intended to prevent the installation of any specific material or method, provided that any such alternative material or system has been approved.

2000 IBC Section 104.11 indicates "...an alternative material, design or method of construction shall be approved where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in the quality, strength, effectiveness, fire resistance, durability and safety." Similar provisions are provided in BNBC/2000 Section 106.4, 1997 UBC Section 104.2.8 and 1999 SBC Section 103.7.

In order to assist building officials in evaluating alternate materials, designs and methods of construction, the model code groups have established independent "evaluation services." BOCA Evaluation Services, Inc. (BOCA ES) provides evaluation services applicable to BOCA's model codes. Similarly, ICBO Evaluation Service, Inc. (ICBO ES) provides evaluation services applicable to ICBO's model codes and SBCCI Public Safety Testing & Evaluation Services, Inc. (SBCCI PST & ESI) provides evaluation services applicable to SBCCI's model codes. Contact information for each of these evaluation service groups is provided in Appendix 1.

Also, each of these groups work together in a mutual organization, National Evaluation Services, Inc. (NES), which provides evaluation services applicable to all three of their model codes. Similarly, BOCA ES and SBCCI PST & ESI work together in an organization, International Evaluation Services (IES), that provides evaluation services applicable to their respective model codes and those of the ICC (e.g., 2000 IBC).

The use of evaluation services provides a means of acceptance of materials that are not specially addressed in the codes. For example, product acceptance criteria for glass fiber-reinforced asphalt shingles is not provided in 1997 UBC, although these products are commonly used in the region of the U.S. in which this code applies. In order to provide acceptance criteria for glass fiber-reinforced asphalt shingles that is applicable to 1997 UBC, ICBO ES established AC127, "Acceptance Criteria for Roofing Systems With Asphalt Shingles Made With Glass Felt." As a result, upon the applicable building code official's acceptance, glass fiber-reinforced asphalt shingles that comply with ICBO ES AC127 comply with 1997 UBC [8].

Use of an evaluation service procedure is also a practical means for newly developed materials and systems to gain recognized acceptance with building officials.

Code Enforcement

The governmental body that enacts a code ordinance has the authority to enforce the specific codes that it adopts [4]. Code enforcement typically takes the form of four primary steps: plan review, permit issuance, on-site field inspection and issuance or maintenance of the certificate of occupancy for the building.

Plan review is the process where the governmental authority having jurisdiction performs a code compliance review of documents relating to a specific project. These documents may include design drawings, engineering calculations, manufacturers' product literature and product approvals or certifications intended to document compliance with the applicable code.

Permit issuance typically entails payment of a fee to the governmental authority having jurisdiction, certification that the work will be preformed in accordance with the applicable codes

and possibly an agreement to notify the authority having jurisdiction at specific milestone points in the project so that the authority can perform its on-site field inspections. Permit fees vary between jurisdictions, but for roofing projects they are typically based on either a uniform established fee for roofing projects or as a percentage of the contract cost of a project. Some jurisdictions do not require payment of fees for roofing projects.

On-site field inspection involves a representative of the authority having jurisdiction performing an inspection of the project while the work is in progress and possibly at the completion of the project. The purpose of on-site field inspection is for the authority having jurisdiction to confirm the work is proceeding in accordance to the code and the applicable plan review and permit.

Upon the successful completion of a project, the authority having jurisdiction will issue a certificate of occupancy for the building. The certificate of occupancy is recognition by the governmental authority having jurisdiction that the subject building is in compliance with the applicable code and is safe to occupy. In the case of reroofing situations on existing buildings where the building was occupied during the roofing work, a new certificate of occupancy is typically not provided. However, in this situation the project is recorded as being completed in compliance with the applicable code and the building continues to be safe to occupy.

A concern of many roofing professionals in the U.S. is that code enforcement varies significantly between jurisdictions and sometimes even within the same jurisdiction. Not all governmental authorities having jurisdiction actively enforce the codes they adopt and some jurisdictions may not require certain enforcement procedures (e.g., plan review, on-site field inspection).

Another form of code enforcement that is becoming more of a concern to roofing professionals is the possibility of code-related litigation. Project designers, material manufacturers, suppliers and contractors involved in specific projects may face civil liability for negligence, as well as contractual liability, if their work associated with the project is not in accordance with the applicable codes [9].

If a construction contract states that the contracted parties shall be responsible for constructing the work in accordance with the building code, these parties can be liable for breach of contract and resulting damages if there is a building code violation. Standardized contract forms sometimes impose a specific contractual obligation to make sure the work complies to applicable codes.

In the absence of a specific contract provision, the parties involved in a roofing project may face claims if their work does not comply with the applicable codes.

In most states, a code violation is considered to be evidence of negligence. In some situations, a code violation may be considered "negligence per se" [9]. This means the parties, for all practical purposes, have no defense to a negligence claim based upon a code violation. Some states have enacted statutes stating that persons who have been injured as a result of a code violation are entitled to bring claims against the party responsible for the code violation.

While code enforcement by the authority having jurisdiction takes place and is completed at the time of construction, code enforcement by the code-related litigation route can take place years after roofing projects have been completed. This form of code enforcement is of increasing concern to roofing professionals in the U.S.

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This paper is dedicated in memory of Ron.Gautreaux, AIA, Vice President and Senior Project Manager with Edward J. Laperouse Metal Works, Inc., Houma, Louisiana, USA. Mr. Gautreaux was active in several NRCA technical committees and was Chairman of NRCA's Building Codes Committee and ASTM Coordination Subcommittee from 1998-2000. During that period, he was instrumental in NRCA's building code-

related efforts including in the development of the *International Building Code*. He had intended to co-author this paper. However, he passed away on April 25, 2000, after an extended illness. Mr. Gautreaux is greatly missed by us at NRCA; however, the results of his efforts will live on.

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Appendices :

Appendix 1
Contact Information for Building Code-Related Organizations

Building Officials and Code Administrators International, Inc. (BOCA)
4051 West Flossmoor Road
Country Club Hills, Illinois 60478-5795
Telephone: (708) 799-2300
Facsimile: (708) 799-4981
Web site: www.bocai.org

BOCA Evaluation Services, Inc. (BOCA ES)
4051 West Flossmoor Road
Country Club Hills, Illinois 60478-5795
Telephone: (708) 799-2305
Facsimile: (708) 799-0310
Web site: www.boca-es.com

Factory Mutual Research (FM)
1151 Boston-Providence Turnpike
Post Office Box 9102
Norwood, Massachusetts 02062
Telephone: (781) 255-4681
Facsimile: (781) 255-0181
Web site: www.fmglobal.com

International Code Council (ICC)
5203 Leesburg Pike, Suite 708
Falls Church, Virginia 22041
Telephone: (703) 931-4533
Facsimile: (703) 379-1546
Web site: www.intlcode.org

International Conference of Building Officials (ICBO)
5360 Workman Mill Road
Whittier, California 90601-2298
Telephone: (562) 699-0541
Facsimile: (562) 692-3852
Web site: www.icbo.org

ICBO Evaluation Service, Inc. (ICBO ES)
International Conference of Building Officials (ICBO)
5360 Workman Mill Road
Whittier, California 90601-2298
Telephone: (562) 699-0543
Facsimile: (562) 695-4694
Web site: www.icbo.org

National Conference of States on Building Codes and Standards, Inc. (NCSBCS)
505 Huntmar Park Drive, Suite 210
Herndon, Virginia 20170
Telephone: (703) 437-0100
Facsimile: (703) 481-3596
Web site: www.ncsbcs.org

National Evaluation Services (NES)
5203 Leesburg Pike, Suite 708
Falls Church, Virginia 22041
Telephone: (703) 931-2187
Facsimile: (703) 931-6505
Web site: www.nateval.org

Southern Building Code Congress International, Inc. (SBCCI)
900 Montclair Road
Birmingham, Alabama 35213-1206
Telephone: (205) 591-1853
Facsimile: (205) 592-7001
Web site: www.sbcci.org

SBCCI Public Safety Testing & Evaluation Services, Inc. (SBCCI PST & ESI)
900 Montclair Road, Suite A
Birmingham, Alabama 35213-1206
Telephone: (205) 599-9800
Facsimile: (205) 599-9850
Web site: www.sbccies.org

Underwriters Laboratories, Inc. (UL)
333 Pfingsten Road
Northbrook, Illinois 60062-2096
Telephone: (847) 272-8800
Facsimile: (847) 272-8129
Web site: www.ul.com

Appendix 2 — Material Requirements for Roof System

Roof Material/System Type	BNBC/99	1997 UBC	1999 SBC	IBC 2000
Asbestos-cement shingles	ASTM C222	ASTM C222	—	—
Asphalt shingles	ASTM D225 or ASTM D3462	UL 55-B	ASTM D225 or ASTM D3462	ASTM D225 or
Mineral-surfaced roll roofing	ASTM D224, ASTM D249, ASTM D371 or ASTM D3909	UL 55-B	—	ASTM D224, ASTM D249, ASTM D371 or ASTM D3909
Clay tile	—	UBC 15-5	ASTM C1167	ASTM C1167
Concrete tile	—	UBC 15-5	SBC 1507.4.5.2	IBC Sec. 1507.3.5
Metal panels	ASTM A361, ASTM A755 or ASTM B101	ASTM A570 or ASTM A611	ASTM A653, ASTM A755, ASTM A792 or ASTM B101	ASTM A653 G-90, ASTM A755, ASTM A792 AZ50 or ASTM B101
Metal shingles	—	ASTM A570 or ASTM A611	ASTM A653, ASTM A755 ASTM A792 or ASTM B101	ASTM A653 G-90, ASTM A755, ASTM A792 AZ50 or ASTM B101
Slate	ASTM C406	ASTM C406	ASTM C406	ASTM C406
Wood shingles	Grade 1, 2 or 3	UBC 15-4	CSSB Grade 1, 2 or 3	CSSB Grade 1, 2 or 3
Wood shakes	—	UBC 15-3	CSSB Grade 1 or 2, or TFS Grade 1 or 2 or	CSSB Grade 1 or 2, TFS Grade 1 or 2
Built-up membrane	ASTM D312, ASTM D450, ASTM D226, ASTM D227, ASTM D2178 or ASTM D4990	ASTM D312 or ASTM D450	ASTM D312, ASTM D450, ASTM D226, ASTM D227, ASTM D2178 or ASTM D4990	ASTM D312, ASTM D450, ASTM D226, ASTM D227, ASTM D2178 or ASTM D4990
Polymer-modified bitumen	CGSB 37-GP-56M	UBC 15-6	ASTM D6162, ASTM D6163, ASTM D6164, or CGSB 37-GP-56M	ASTM D6162, ASTM D6163, ASTM D6164, or CGSB 37-GP-56M
Thermoset single-ply	RMA RP-1, RMA RP-2, RMA RP-3, ASTM D4637, or CGSB 37-GP-52M	UBC 15-6	RMA RP-1, RMA RP-2, RMA RP-3, ASTM D4637, or CGSB 37-GP-52M	RMA RP-1, RMA RP-2, RMA RP-3, ASTM D4637, or CGSB 37-GP-52M
Thermoplastic single-ply	ASTM D4434 or CGSB 37-GP-54M	UBC 15-6	ASTM D4434 or CGSB 37-GP-54M	ASTM D4434 or CGSB 37-GP-54M
Spray polyurethane foam	ASTM C1029	—	ASTM C1029	ASTM C1029
Liquid-applied	ASTM C836, ASTM C957, ASTM D1227 or ASTM D3468	—	ASTM C836, ASTM C957, ASTM D1227 or ASTM D3468	ASTM C836, ASTM C957, ASTM D6083, ASTM D1227 or ASTM D3468

Key: American Society for Testing and Materials (ASTM); Canadian General Standards Board (CGSB); Cedar Shake and Shingle Bureau (CSSB); Rubber Manufacturers Association (RMA); Forest Products Laboratory of the Texas Forest Service (TFS); Underwriters Laboratories, Inc. (UL); Uniform Building Code (UBC)