September 5-14, 2003
Proposed Changes to the 2003 ICC Edition
Structural

S1-03/04
1504.8

Proponent: John V. Loscheider, P.E., Loscheider Engineering Company, representing Structural Engineers Association of Washington

Add new text as follows:

1504.8 Gravel and stone. Gravel or stone shall not be used on the roof of a building located in a hurricane prone region as defined in Section 1609.2, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the building site.

TABLE 1504.8
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR BUILDINGS WITH GRAVEL OR STONE ON THE ROOF IN AREAS OUTSIDE A HURRICANE-PRONE REGION

BASIC WIND SPEED FROM FIGURE 1609 (mph)[b]	MAXIMUM MEAN ROOF HEIGHT (ft.)[a,d]		
	Exposure category[c]		
	B	C	D
85	170	60	30
90	170	35	15
95	75	20	NP
100	55	15	NP
105	40	NP	NP
110	30	NP	NP
115	20	NP	NP
120	15	NP	NP
Greater than 120	NP	NP	NP

a. Mean roof height in accordance with Section1609.2.
b. For intermediate values of ba sic wind speed, the height associated with the next higher value of wind speed shall be used, or direct interpolation is permitted.
c. Exposure category determined from Section 1609.4 when Section 1609.6 is used to determine design wind pressures. When the provisions of Section 6 of ASCE 7 are used to determine the design wind pressures, the exposure category shall be the most restrictive of all the categories determined for the building.
d. NP = gravel and stone not permitted for any roof height.

Reason: The purpose of this proposal is to reduce the loss of property resulting from high winds.

Field assessments of damage to buildings caused by high wind events have shown that gravel or stone blown from the roofs of buildings has exacerbated damage to other buildings due to breakage of glass. Once glass is broken, higher internal pressures are created within the building. This higher pressure, which in most cases was not considered in design, can result in substantial structural damage to interior walls, and to the cladding of walls and roof surface subjected to negative external pressures. Even where the higher internal pressure is considered and the building designed accordingly, the breakage of windows will generally result in substantial wind and water damage to the building's interior and contents.

ASCE 7 and the IBC have addressed the wind-borne debris issue by requiring some buildings to have impact-resistant glazing or the glazing protected with impact resistant covers. As an alternate to

protection of glazing, the building must be designed to withstand the additional internal pressure to which it will be subjected if glazing is broken. Neither of these protection schemes address the root problem, which is debris becoming airborne during high winds. In addition, the provisions do nothing to protect existing buildings.

NFPA 5000 (Section 38.4.4) has addressed the issue and is attempting to control the amount of debris by prohibiting the use of gravel or stone on roofs of buildings in hurricane-prone regions, and on buildings over 60 feet in height that are located outside such regions.

This proposal addresses the issue a little differently for areas that are not within a hurricane-prone region. Both the IBC and ASCE 7 define a wind-borne debris region as areas within a hurricane-prone regions region within 1 mile of the coastal mean high water line where the basic wind speed is 110 mph or greater, or where the basic wind speed is 120 mph or greater, or in Hawaii. Since it is applicable everywhere within a hurricane-prone region where the basic wind speed is 120 mph or greater, the concern is that the velocity pressure at or near the ground is great enough to cause debris or other unsecured objects to become airborne. Obviously stone, gravel or other unsecured objects on the roof of a building may also become airborne and possibly break glass in buildings downwind.

The IBC and ASCE 7 imply that the velocity pressure, Kz, associated with a wind speed of 120 mph at or near the ground in exposure category B is the threshold pressure at which loose objects may become airborne. For these conditions, the velocity pressure is approximately 17.9 pounds per square foot. This assumes that the directional factor, Kd, equals 0.85, and that the topographic factor, Kzt, and importance factor, I, equal 1.0. Using this velocity pressure (17.9), the allowable mean roof height was calculated for various basic wind speeds and exposure categories, and rounded to the nearest five feet.

Cost Impact: None

Committee Action: **Approved as Submitted.**

Committee Reason: Experience with hurricanes indicates that damage due to gravel and stone on roofs becoming airborne has bee a real problem.

Assembly Action: **None**

May 17-20, 2004
2004 Final Action Agenda for the Proposed Changes to the 2003 ICC

S1-03/04
1504.8

Proposed Change as Submitted:

Proponent: See above.

Add new text as follows: see above.

Cost Impact: None

Committee Action: Approved as Submitted

Committee Reason: Experience with hurricanes indicates that damage due to gravel and stone on roofs becoming airborne has been a real problem.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because a public comment was submitted.

Public Comment:

David L. Roodvoets, DLR Consultants, representing SPRI, requests Disapproval.

Commenter's Reason: This proposed code change is unnecessary as gravel & stone are appropriately regulated under section 1504.4 Ballasted Low Slope Roofing Systems. 1504.4 by reference to ANSI/SPRI RP-4 limits ballasted roofs to building heights 150' or less, and requires parapets for roofs that are over 75' tall. (This code change allows buildings up to 170' tall with no parapet.) RP-4 addresses the wind borne debris issue by limiting the ballast used to #2 ballast which requires that all stone used in wind borne debris area to be ASTM D448 #2 stone which is nominal 2.5" stone. RP-4 also eliminates all stone from the perimeter and corner areas (designated as 8.5 foot or 0.4 times the building height, whichever is greater) in all wind zones greater than 120 mph. RP-4 is based on scientific wind tunnel studies of ballast movement, verified by field studies and over 25 years of actual performance data. (Total roof area more than 10 billion square feet) The wind tunnel studies of ballast systems do not correlate ballast movement with any given velocity pressure, but do emphasize the value of parapets and the effect of perimeter areas. Wind engineers know that the velocity pressure argument does not apply to gravel ballasted systems.

As just one example in both wind tunnel and field studies there was no movement of ASTM D448 #4 stone (1.5" nominal) on a 30' tall building in 100mph 3-second gust winds. The code related velocity pressure for the corner area of this exposure C roof is 75 pounds per square foot. The ballast weight was 10 pounds per square foot, there was nominal 2" gravel stop at the perimeter, and nothing moved.

This proposed code change covers all types of stone and gravel; it does not segregate the small pea gravel that is imbedded into asphalt and coal tar from ballast stone for sheet membranes. Both systems can be better addressed with a specific code change that addresses the requirements for pea gravel independently from the current ballast requirements in section 1504.4.

Ballasted roofs also provide superior fire resistance, especially fire resistance from without, as burning brands are not likely to heat through the ballast and ignite the systems below. Although there have been instances of gravel breaking windows of adjacent buildings, the roof design and gravel did not comply with RP-4. This proposed code change does not fix anything and could create serious problems.

February 22 – March 4, 2005
Volume 1, Proposed Changes to the 2003 ICC Editions
Structural

FS185-04/05
1504.8, Table 1504.8

Proponent: David L. Roodvoets, DRL Consultants, Montague, MI, representing SPRI

THIS PROPOSAL IS ON THE AGENDA OF THE IBC STRUCTURAL CODE DEVELOPMENT COMMITTEE. SEE THE TENTATIVE HEARING ORDERS FOR THE IBC STRUCTURAL CODE DEVELOPMENT COMMITTEE.

1. Revise as follows:

1504.8 (Supp) Gravel and stone. Gravel or stone shall not be used on the roof of a building located in a ~~hurricane prone~~ wind borne region as defined in Section 1609.2. ~~or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the building site.~~ Gravel or stone smaller than ASTM D 448 size # 2 shall not be permitted in hurricane prone regions where the wind speed as defined in Section 1609.2 is greater than110mph. Graveled or stone surfaced built up roofs are permitted in wind zones including 110 mph, when the gravel or stone is fully imbedded into the asphalt or coal tar flood coat. Loose Gravel & Stone larger than ASTMD448 size #5 shall be permitted when the roof height and wind zones comply with the requirements of ANSI/SPRI RP-4.and the limitations of this section. Loose gravel or stone smaller that ASTM D448 size #5 shall not be permitted on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the building site.

TABLE 1504.8 (Supp)
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR BUILDINGS WITH GRAVEL OR STONE SMALLER THAN ASTM D488 SIZE #5 ON THE ROOF IN AREAS OUTSIDE A HURRICANE-PRONE REGION

BASIC WIND SPEED FROM FIGURE 1609 (mph)[b]	MAXIMUM MEAN ROOF HEIGHT (ft.)[a,d]		
	Exposure category[c]		
	B	C	D
85	60 ~~170~~	60	30
90	60 ~~170~~	35	15
95	60 ~~75~~	20	NP
100	45 ~~55~~	15	NP
105	30 ~~40~~	NP	NP
110	NP ~~30~~	NP	NP
115	NP ~~20~~	NP	NP
120	NP ~~15~~	NP	NP
Greater than 120	NP	NP	NP

a. through c. (No change to current text)
d. NP = Loose gravel and stone smaller than ASTM D448 size #5 not permitted for any roof height.

2. Add new standard to Chapter 35 as follows:
ASTM D448-03a Standard Classification for Sizes Of Aggregate for Road and Bridge Construction . . . . . Table 1504.8

Reason: Extensive wind tunnel experimentation and field observation have shown that stone with an average size equivalent to ASTM D448 #2 can provide wind stable systems at very high wind speeds. Wind tunnels studies of stone stability were used to develop ANSI/SPRI RP-41; which provides a conservative design to prevent stone blow off. This change increases the reserve capacity (safety factor) of the system as it eliminates the use of all stone or gravel in wind borne debris areas and only allows the much larger sized stone in other areas. All wind tunnel work and field experimentation has been conducted with readily available stone mixtures that model the ASTM D448 stone in the wind tunnel, or were graded as ASTM D448 stone in field validation experiments2. These stone gradations do contain stone of many sizes including stone less than 0.5 inches in diameter. All science however has shown that the stone on rooftops, the sand on beaches or deserts or any place that gradations of aggregate exist; the aggregate responds to the wind based on the mean size of the aggregate. (This fact can be proven by going to any windswept sand beach and measuring the gradation of the sand at waters edge and the top of a dune, or by measuring any sized aggregate that has been disturbed by wind). This allows the modeling that was conducted to establish ANSI/SPRI RP-4. The revised table significantly restricts the use of small loose stones or gravel based on the potential for these to be blown off roofs. The history of

these systems; which is about 100 years in the United States, has shown very little potential for this sized aggregate to be blown from a roof. The few dramatic incidents that have been reported were always due to a set of conditions not normal to typical roofs in use. (The stone damage from Hurricane Alicia in Houston was from a building being re-roofed.) The building height and wind speed limitations eliminate the installation of the loose small stones in high wind areas. The requirement for fully imbedded gravel has been included in codes in hurricane prone areas for years. Techniques exist for accomplishing this and it has been acceptable to the contractors and authorities having jurisdiction in these cities.

1. Kind, R.J. and Wardlaw, R.L., Design of Rooftops Against Gravel Blow-Off, National Research Council of Canada, Report No. 15544, September 1976.
2. Proceedings of the Ballasted Single-Ply System Wind Design Conference, held in Carlisle, PA, 1984.

Analysis: Staff had not reviewed the proposed referenced standard prior to the printing of the monograph. Staff will review it and provide the results at the ICC website prior to the code change hearings.

Cost Impact: None

Note: Revise original analysis as published in the monograph as follows:

Analysis. The referenced standard proposed for addition to the code, ASTM D448, was found to meet the ICC Criteria for referenced standards.

Committee Action: Disapproved

Committee Reason: The proposed reference standard is not appropriate for gravel and stone used on roofs.

Assembly Action: None

Proponent: Mark S. Graham, James R. Kirby, National Roofing Contractors Association

Add new definition as follows:

1502.1 General. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

AGGREGATE: In roofing, crushed stone, crushed slag or water-worn gravel used for surfacing a built-up roof covering or modified bitumen roof covering.

Reason: This proposed code change adds a new definition to the code.

Cost Impact: The code change proposal will not increase the cost of construction.

Committee Action: Approved as Modified

Modify proposal as follows:

AGGREGATE: In roofing, crushed stone, crushed slag or water-worn gravel used for surfacing ~~a built-up~~ for roof coverings ~~or modified bitumen roof covering~~.

Committee Reason: The definition will provide a concise explanation of the term aggregate. The modification removed references to specific types of roof coverings to address the concern that, as written, the definition would not apply to single ply roof coverings.

Assembly Action: None

Individual Consideration Agenda

This item is on the agenda for individual consideration because public comments were submitted.

Public Comment 1:

Joann E. Surma, The Dow Chemical Company, requests Approval as Submitted.

Commenter's Reason: The Dow Chemical Company has been successfully working with builders, contractors and architects for over 30 years in the area of Protected Membrane Roof Assemblies (PMR). These PMR assemblies utilize stone and gravel as the ballast mechanism. Attached is a letter from Dow's National Roofing Warranty Manager documenting the successful field performance of these ballasted roofing systems using the parameters defined in proposal FS185-04/05. We urge approval of this proposal.

Public Comment 2:

Jared O. Blum, EPDM Roofing Association, representing ERA Members and Associate Members, requests Approval as Modified by this public comment.

Modify proposal as follows:

1504.8 (Supp) Gravel and stone. Gravel or stone shall not be used on the roof of a building located in a wind borne region as defined in Section 1609.2. Gravel or stone smaller than ASTM D 448 size # 2 shall not be permitted in hurricane prone regions where the basic wind speed as defined in Section 1609.2 is ~~greater than~~ 110 mph or greater. ~~Graveled or stone surfaced built up roofs are permitted in wind zones including 110 mph, when the gravel or stone is fully imbedded into the asphalt or coal tar flood coat.~~ Loose gravel or stone larger than ASTM D448 size #5 shall be permitted when the roof height and wind zones comply with the requirements of ANSI/SPRI RP-4 ~~and the limitations of this section~~. Loose gravel or stone complying with ASTM D1863 or smaller than ASTM D448 ~~size~~ gradation #5 shall not be permitted on any ~~other~~ building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the building site.

TABLE 1504.8
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR BUILDINGS WITH GRAVEL OR STONE COMPLYING WITH ASTM D1863 OR SMALLER THAN ASTM D488 BALLAST GRADATION SIZE #5 ON THE ROOF IN AREAS OUTSIDE A HURRICANE-PRONE REGION

(Return table contents to current text)
a. through c. (No change to current text)
d. NP = ~~Loose~~ Gravel and stone smaller than ASTM D448 size #5 not permitted for any roof height.

Commenter's Reason: This modified proposal leaves the table entitled MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR BUILDINGS WITH GRAVEL OR STONE, as it currently exists in the published code, but adds the standard for the small gravel ballast typically used on graveled Built Up Roofs (BUR). (ASTMD1863 is referenced in the International Building Code Table 1507.10.2) Small ballast stones such as ASTM D448* #5 that are typically 0.75" in diameter, and smaller gradations, such as ASTM D448 #6 or ASTM D1863 are used as surfacing for BUR roofs.

This proposed modification continues the allowance of stones that comply with ANSI/SPRI/RP-4. In areas where the wind speed is 110 mph or greater the ballast stone size is limited to very large stones (ASTM D448-Number 2), which are typically 2.5" in diameter and often up to 8" long.

There appears to be no substantiated data to support the reason to restrict the use of ballast more than currently required by ANSI/SPRI/RP-4. Ballasted roofs are the most fire safe system available, they are

low cost and they provide verified energy savings. Ballasted systems extend roof membrane life and are installed on nearly 500 million square feet of roof per year!

Roof top Investigations of performance of ballasted roofs exposed to the winds of hurricane Charley, and Ivan in 2004 by RICOWI (The Roof Industry Committee on Weather Issues) found that all of the gravel ballasted roofs using ASTM D448 #4 or larger stones performed better than predicted based on the design requirements of ANSI/SPRI/RP-4.

Most stone found on the ballasted roofs in the hurricane damage area was typical ASTM D448 #4 gradation. This stone did not blow off roofs in winds of 130 mph and greater. Some #4 stone was moved on the roof, but did not blow off where the wind speed was greater than 130mph. A gust wind speed of 130 mph is 25 mph faster than the highest design wind speed (105mph) allowed by ANSI/SPRI/RP-4 for ASTM #4 stone.

This proposed modification will still allow the use of ballast that complies with ANSI/SPRI/RP-4*. In areas where the wind speed is
designated by ANSI to be 110 mph or greater the ballast size is limited to ballast in compliance with ASTM D448-Number 2, in which the average size of the stone ballast is typically 2.5" in diameter. The ANSI/SPRI/RP-4** document has been the standard in the industry and has provided quality guidance to architects, engineers and roof consultant and has become a standard that all roof system designers have in their library. As such, there is no reason to restrict the use of ballast more than currently required by ANSI/SPRI/RP-4. Ballasted roofs are the most fire resistant system available today, provide verified energy savings and are cost effective. Ballasted systems, through the characteristic of shading the membrane from the effects of the ultraviolet radiation extends roof system service life. Additionally RICOWI (Roof Industry Committee on Weather Issues has reported that ballast also protect roof systems from the damaging effects of even the largest hail stone.

Please accept the As Modified version of the code change.

* ASTM D448 is a method of determining the gradation of stone. It is used for most of the stone gradation in the United States as most stone is used in construction of roads and bridges. ASTM D448 has been the basis for determining the aggregate size in all of the wind tunnel and field experiments for ballasted systems since the early 1970's. The smaller the gradation number in ASTM D448 the larger the stone size.

**ANSI/SPRI/RP-4 was created in response to concerns of code authorities in the 1980's and has been used by code officials to ensure wind stability of ballasted roofs since that time with excellent results. ANSI/SPRI/ RP-4 was developed based on wind tunnel results using modeled gradation of the typical ASTM D448 stones, including the smallest stones. The wind tunnel results were compared to actual field experience with stone ballasted roofs that were exposed to hurricanes and Colorado front range storms. The systems performance has been verified consistently since this early work.

Public Comment 3:

Dick Gillenwater, Carlisle SynTec Inc., requests Approval as Modified by this public comment.

Same as modification in public comment #2.

Commenter's Reason: Ballasted systems have been around since the early 1970's. Because of it simplistic design, ease of installation, and low close, the ballasted system became the fastest growing roof system at that time and eventually reached 20% of the total roofing market. Because of its quick growth, there were some wind problems with the system in the late 70's and early 80's. In response to this, the industry came together to develop design standards to address this issue. The base for the eventual system design guide was extensive wind tunnel tests that were conducted at the National Research Council of Canada, which has the largest commercial wind tunnel in the world. This work was field verified through comparisons with the COMPIS study conducted by Schneider and Associates

architectural firm that looked at 40 roofs that had gone through a major Chinook wind event along the front range of the of the Rockies. One of those building evolved was the Wind Energy Center in Bolder, Colorado where an engineer documented the roof event. In addition, two major cold fronts through the mid west and four hurricanes were investigated and compared to the wind tunnel work. One of those hurricanes was Alicia that hit Houston where there was major window breakage due to gravel coming off of gravel surface Built Up Roof systems. There were four ballasted EPDM roof systems in the center of town with none of them having any scour let alone any rock leaving the roof. This work lead to the development of the first ANSI RP-4 “Wind Design Standard for Ballasted Roofing Systems” issued in 1987. An additional eight hurricanes and other wind events were monitored with this information used to refine RP-4 in future revisions. The latest data that came out of the RICOWI (The Roof Industry Committee on Weather Issues) study of the hurricane events in Florida in 2004 found that the RP-4 is conservative for all of the gravel ballasted roofs using ASTM D448 #4 or larger stones performed better than predicted based on the design requirements of ANSI/SPRI/RP-4.

For this reason, the As Modified proposal leaves the table as it currently exists in the code, and adds the standard for the small gravel typically used on graveled Built Up Roofs (BUR). (ASTMD1863 is referenced in the International Building Code Table 1507.10.2) Small stones such as ASTM D448 #5 stones that are typically 0.75” in diameter, and smaller stone gradations, such as ASTM D448 #6 or ASTM D1863 are used as surfacing for BUR roofs.

ASTM D448 is a method of determining the gradation of stone. It is used for most of the stone gradation in the United States as most stone is used in construction of roads and bridges. ASTM D448 has been the basis for determining the aggregate size in all of the wind tunnel and field experiments for ballasted systems since the early 1970’s. The smaller the gradation number in ASTM D448 the larger the stone size.

This proposed modification continues the allowance of stones that comply with ANSI/SPRI/RP-4. In areas where the wind speed is 110 mph or greater the stones size is limited to very large stones (ASTM D448-Number 2), which are typically 2.5” in diameter.

There is no reason to restrict the use of ballast more than currently required by ANSI/SPRI/RP-4. Ballasted roofs are the most fire safe system available, they are low cost and they provide verified energy savings equal to white roofing systems. Ballasted systems extend roof membrane life and are installed on nearly 500 million square feet of roof per year.

Please accept the As Modified version of the code change.

Public Comment 4:

David L. Roodvoets, DLR Consultants, representing SPRI, requests Approval as Modified by this public comment.

Same as modification in public comment #2.

Commenter’s Reason: The As Modified proposal leaves the table as it currently exists in the code, and adds the standard for the small gravel typically used on graveled Built Up Roofs (BUR). (ASTMD1863 is referenced in the International Building Code Table 1507.10.2) Small stones such as ASTM D448 #5 stones that are typically 0.75” in diameter, and smaller stone gradations, such as ASTM D448 #6 or ASTM D1863 are used as surfacing for BUR roofs.

ASTM D448 is a method of determining the gradation of stone. It is used for most of the stone gradation in the United States as most stone is used in construction of roads and bridges. ASTM D448 has been the basis for determining the aggregate size in all of the wind tunnel and field experiments for ballasted systems since the early 1970’s. The smaller the gradation number in ASTM D448 the larger the stone size.

This proposed modification continues the allowance of stones that comply with ANSI/SPRI/RP-4. In areas where the wind speed is 110 mph or greater the stones size is limited to very large stones (ASTM D448-Number 2), which are typically 2.5" in diameter.

There is no reason to restrict the use of ballast more than currently required by ANSI/SPRI/RP-4. Ballasted roofs are the most fire safe system available, they are low cost and they provide verified energy savings. Ballasted systems extend roof membrane life and are installed on nearly 500 million square feet of roof per year.

Investigations of performance of roofs exposed to the winds of hurricane Charley, and Ivan in 2004 by RICOWI (The Roof Industry Committee on Weather Issues) found that all of the gravel ballasted roofs using ASTM D448 #4 or larger stones performed better than predicted based on the design requirements of ANSI/SPRI/RP-4.

Most stone found on ballasted roofs in the hurricane damage area was typical ASTM D448 #4 gradation. This stone did not blow off roofs in winds of 130 mph and greater. Some #4 stone was moved on the roof, but did not blow off where the wind speed was greater than 130mph. A gust wind speed of 130 mph is 25 mph faster than the highest design wind speed (105mph) allowed by ANSI/SPRI/RP-4 for ASTM #4 stone.

ANSI/SPRI/RP-4 was created in response to concerns of code authorities in the 1980's and has been used by code officials to ensure wind stability of ballasted roofs since that time with excellent results. ANSI/SPRI/ RP-4 was developed based on wind tunnel results using modeled gradation of the typical ASTM D448 stones, including the smallest stones. The wind tunnel results were compared to actual field experience with stone ballasted roofs that were exposed to hurricanes and Colorado Front Range storms.

The systems performance has been verified consistently since this early work.

Please accept the As Modified version of the code change.

Public Comment 5:

Thomas W. Hutchinson, Hutchinson Design Group, Ltd., representing himself, requests Approval as Modified by this public comment.

Modify proposal as follows:

1504.8 (Supp) Gravel and stone. Gravel or stone shall not be used on the roof of a building located in a wind borne region as defined in Section 1609.2. Gravel or stone smaller than ASTM D 448 size # 2 shall not be permitted in hurricane prone regions where the basic wind speed as defined in Section 1609.2 is ~~greater than~~ 110 mph or greater. ~~Graveled or stone surfaced built up roofs are permitted in wind zones including 110 mph, when the gravel or stone is fully imbedded into the asphalt or coal tar flood coat.~~ Loose gravel or stone larger than ASTM D448 size #5 shall be permitted when the roof height and wind zones comply with the requirements of ANSI/SPRI RP-4 ~~and the limitations of this section~~. Loose gravel or stone complying with ASTM D1863 or smaller than ASTM D448 ~~size #5~~ gradation #4 shall not be permitted on any ~~other~~ building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the building site.

TABLE 1504.8
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR BUILDINGS WITH GRAVEL OR STONE COMPLYING WITH ASTM D1863 OR SMALLER THAN ASTM D488 BALLAST GRADATION SIZE ~~#5~~ #4 ON THE ROOF IN AREAS OUTSIDE A HURRICANE-PRONE REGION

(Return table contents to current text)

a. through c. (No change to current text)

d. NP = ~~Loose~~ Gravel and stone smaller than ASTM D448 size #5 not permitted for any roof height.

Commenter's Reason: This proposed modification leaves the above shown table as it currently exists in the code, while adding the standard for the gravel ballast typically used on gravel surfaced Built Up Roofs (BUR). The table would thus be in agreement with current wind science.

This proposed modification will still allow the use of ballast that complies with ANSI/SPRI/RP-4*. In areas where the wind speed is designated by ANSI to be 110 mph or greater the ballast size is limited to ballast in compliance with ASTM D448-Number 2, in which the average size of the stone ballast is typically 2.5" in diameter.

The ANSI/SPRI/RP-4 document has been the standard in the industry and has provided quality guidance to architects, engineers and roof consultant and has become a standard that all roof system designers have in their library. As such, there is no reason to restrict the use of ballast more than currently required by ANSI/SPRI/RP-4. Ballasted roofs are the most fire resistant system available today, provide verified energy savings and are cost effective. Ballasted systems, through the characteristic of shading the membrane from the effects of the ultraviolet radiation extends roof system service life. Additionally RICOWI (Roof Industry Committee on Weather Issues has reported that ballast also protect roof systems from the damaging effects of even the largest hail stone. Additionally, in the field investigation in the areas of Florida which experienced hurricane activity in 2004 found that ballasted roof systems performed even better than anticipated by ANSI/SPRI/RP-4

Please accept the As Modified version of the code change.

*ANSI/SPRI/RP-4 was created in response to concerns of code authorities in the 1980's and has been used by code officials to ensure wind stability of ballasted roofs since that time with excellent results. ANSI/SPRI/ RP-4 was developed based on wind tunnel results using modeled gradation of the typical ASTM D448 stones, including the smallest stones. The wind tunnel results were compared to actual field experience with stone ballasted roofs that were exposed to hurricanes and Colorado front range storms. The systems performance has been verified consistently since this early work.

September 20 – October 1, 2006
Volume 1, Proposed Changes to the 2006 Edition
Structural

FS186–06/07
1502 (New), Chapter 35

Proponent: David L. Roodvoets, DLR Consultants, representing Single-ply Roofing Institute, Inc. (SPRI)

1. Add new definition as follows:

BALLAST: Ballast is any item having weight that is used to hold or steady an object. In roofing, ballast comes in the form of Large Stones (ASTM D448 #4 or larger) or paver systems or light-weight interlocking paver systems and is used to provide uplift resistance for roofing systems that are not adhered or mechanically attached to the roof deck.

2. Add standard to Chapter 35 as follows:

ASTM
D448-03a Standard Classification for Sizes of Aggregate for Road and Bridge Construction

Reason: This addition to the code provides a definition that segregates ballast materials used for wind uplift resistance from other aggregates used on roofs.

There is no definition given for ballast in the standard therefore causing confusion for users of the code between the materials used to provide wind uplift on roofs and smaller aggregate that is used on adhered roofing systems to add fire and weather protection.

The term ballasted was adopted by the roofing industry in the 1970's to describe the use of large stones or pavers to provide wind resistance for roofing systems that were not adhered to the deck. These systems have had extensive use for over 25 years, and have had extensive wind tunnel testing and field evaluations, as well as an excellent track record for performance in high winds.

Cost Impact: The code change proposal will not increase the cost of construction.

Analysis: Results of the review of the proposed standard(s) will be posted on the ICC website by August 20, 2006.

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

FS192–06/07

1504.2, 1504.3, 1504.8 and Table 1508.4

Proponent: Philip Brazil, P.E., Reid Middleton, Inc., representing himself

THIS PROPOSAL IS ON THE AGENDA OF THE STRUCTURAL CODE DEVELOPMENT COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THAT COMMITTEE.

Revise as follows:

1504.2 Wind resistance of clay and concrete tile. Wind loads on ~~C~~ clay and concrete tile roof coverings shall be ~~connected to the roof deck~~ in accordance with ~~Chapter 16~~ Section 1609.5.

1504.3 Wind resistance of nonballasted roofs. Roof coverings installed on roofs in accordance with Section 1507 that are mechanically attached or adhered to the roof deck shall be designed to resist the design wind load pressures for components and cladding in ~~Chapter 16~~ accordance with Section 1609.

1504.8 Gravel and stone. Gravel or stone shall not be used on the roof of a building located in a hurricane-prone region as defined in Section 1609.2, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the ~~building~~ site.

TABLE 1504.8
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR BUILDINGS WITH GRAVEL OR STONE ON THE ROOF IN AREAS OUTSIDE A HURRICANE-PRONE REGION

BASIC WIND SPEED FROM FIGURE 1609 (mph)[b]	MAXIMUM MEAN ROOF HEIGHT (ft.)[a,d]		
	Exposure category[c]		
	B	C	D
85	170	60	30
90	170	35	15
95	75	20	NP
100	55	15	NP
105	40	NP	NP
110	30	NP	NP

115	20	NP	NP
120	15	NP	NP
Greater than 120	NP	NP	NP

For SI: 1 foot = 304.8 mm; 1 mile per hour = 0.447 m/s.
a. Mean roof height ~~in accordance with Section 1609.2~~ as defined in ASCE 7.
b. For intermediate values of basic wind speed, the height associated with the next higher value of wind speed shall be used, or direct interpolation is permitted.
c. NP = gravel and stone not permitted for any roof height.

Reason: The purpose for the proposal is to update the provisions of Section 1504 on performance requirements for roof decks and roof covering to be more consistent with current structural provisions in Chapter 16. Section 1504.2 on clay and concrete tile roof coverings is revised from a requirement to be connected in accordance with Chapter 16 to a determination of wind loads in accordance with Section 1609.5 because the only identified reference to clay and concrete tile roof coverings in Chapter 16 is in Section 1609.5, which specifies how to determine wind loads (Section 1609.5.3) and wind pressures (Section 1609.5.1) but does not specify required connections.

Section 1609.5.1 requires the roof deck to be designed to withstand the wind pressures determined in accordance with ASCE 7. Section 1609.5.2 requires roof coverings to comply with Section 1609.5.1 except for rigid tile roof coverings that are air permeable and installed over a roof deck complying with Section 1609.5.1, which are permitted to comply with Section 1609.5.3.

A change to the title of Section 1504.2 is not proposed in order to maintain consistency with the titles to Sections 1504.1 (wind resistance of roofs) and 1504.3 (wind resistance of ballasted roofs), and with the subject of Section 1504.2.1, which refers to the resistance of shingles to uplift forces.

The proposed changes to Section 1504.3 are editorial. The deletion of “building” from Section 1504.8 is being done because the provisions of the IBC apply to structures as well as buildings. The revision to Footnote (a) of Table 1504.8 is being done because Section 1609.2 does not define mean roof height but that definition is found in Section 6.2 of ASCE 7-05.

Cost Impact: The code change proposal will not increase the cost of construction.

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

FS196–06/07
1504.4

Proponent: David L. Roodvoets, DLR Consultants, representing Single-ply Roofing Institute, Inc. (SPRI)

THIS PROPOSAL IS ON THE AGENDA OF THE IBC STRUCTURAL CODE DEVELOPMENT COMMITTEES. SEE THE TENTATIVE HEARING ORDERS FOR THESE COMMITTEES.

Revise as follows:

1504.4 Ballasted low-slope roof systems. Ballasted low-slope (roof slope < 2:12) single-ply roof system coverings installed in accordance with Sections ~~1507~~ 1507.12 and 1507.13 shall be designed in accordance with ~~Section 1504.8 and~~ ANSI/SPRI RP-4.

Reason: Clarify which specific sections in 1507 - Requirements for Roof Coverings, involve low slope Ballasted systems and that the ballast used is large stone.

There is confusion by users of the code between the materials used to provide wind uplift on roofs and smaller aggregate that is used on adhered roofing systems to add fire and weather protection.

Ballasted single ply membranes performed very well in the recent hurricanes, see examples from the RICOWI report, again verifying that ANSI/SPRI RP-4 provides the design tools to install roofing systems that meet the required design. This change clearly separates the requirements for systems that use ballast for wind resistance from those systems that use smaller aggregate for fire and weather protection.

TYPE OF STRUCTURE—Hospital
EXPOSURE—B
WALL CONSTRUCTION—Concrete with EIFS cladding
ROOF TYPE—Single-ply membrane
ROOF PITCH—¼ " : 12
ROOF DECK—Cast-in-place concrete

CONSTRUCTION—The building is one of many on the site and is constructed mostly of substantial steel frame construction with original rock aggregate precast concrete exterior panels that had been retrofitted with an EIFS exterior cladding system. The roof deck, which is about 30 ft above grade, appears to be cast-in-place concrete. This roof has a gravel stop edge.

The Escambia inlet bay could be seen to the east and south from the roofs, yet the surrounding terrain would qualify as Exposure B, according to

ASCE 7-02, with a height of surface roughness of about 25 to 30 ft above grade. Streets and parking lots create open areas on the east, northeast, south, and southeast side of the structure across the street, as well as adjacent to the structure.

ROOF MEMBRANE SYSTEM—The membrane was a loose-laid ballasted white reinforced elastomeric sheet single-ply membrane (Hypalon), The ballast was similar to ASTM 448 #4 or larger (average 1.5-in. with stones up to 2 in.) The membrane was installed over tapered Isocyanurate insulation.

DAMAGE CONDITIONS—No membrane damage was noted. There was a small amount of gravel scour at the windward side, at corners, and around penthouses. There were no signs that gravel had left the roof. Ballast scour may occur, based on previous wind studies, for winds over 115 mph at this building height. Some of the partially adhered, 1/2-in.-thick rubber walk pads had become loose from the membrane; some may have blown off the roof. A 30 to 40 ft segment of the snap on fascia edge metal cover become disengaged from its cleat and had blown off. An exhaust fan had also blown off the roof.

DAMAGE INITIATION—The shop-fabricated metal edge was clamped over an existing gravel stop. The cleat, although continuous, was thin and could not resist the bending forces of the fascia.

OTHER COMMENTS —This roof was a survivor. There were no known leaks, and the ballast remained on the roof. The damage to the edge was repairable. The section of the hospital had been closed because the windows in the east-facing wall leaked so badly that water was blowing into the patient rooms. They expected to have the area back in operation as soon as the rooms were dried out.

Cost Impact: The code change proposal will not increase the cost of construction.

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

FS198–06/07

1504.8, Table 1504.8

Proponent: Mark S. Graham, James R. Kirby, National Roofing Contractors Association

THIS PROPOSAL IS ON THE AGENDA OF THE IBC STRUCTURAL CODE DEVELOPMENT COMMITTEE. SEE THE TENTATIVE HEARING ORDER FOR THIS COMMITTEE.

Revise as follows:

1504.8 ~~Gravel and stone~~. **Aggregate.** ~~Gravel or stone~~ Aggregate shall not be used on the roof of a building located in a hurricane-prone region as defined in Section 1609.2, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the building site.

TABLE 1504.8
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR BUILDINGS WITH ~~GRAVEL OR STONE~~ AGGREGATE ON THE ROOF IN AREAS OUTSIDE A HURRICANE-PRONE REGION

(No changes to table text)

Reason: This proposed code change is intended to clarify the intent of Section 1504.8. The terms "gravel and stone" are not used elsewhere in Chapter 15. The term "aggregate" is already used in Table 1507.10.2.

Cost Impact: The code change proposal will not increase the cost of construction.

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

September 20 – October 1, 2006
2006 Report of the Public Hearing on the 2006 Edition International Building Code Structural Committee Hearing Results

FS185–06/07

Committee Action: Approved as Modified

Modify proposal as follows:

AGGREGATE: In roofing, crushed stone, crushed slag or water-worn gravel used for surfacing ~~a built-up~~ for roof coverings ~~or modified bitumen roof covering~~.

Committee Reason: The definition will provide a concise explanation of the term aggregate. The modification removed references to specific types of roof coverings to address the concern that, as written, the definition would not apply to single ply roof coverings.

Assembly Action: None

FS186–06/07

Note: The following analysis was not in the Code Change Proposal book but was published in the "Errata to the 2006/2007 Proposed changes to the International Codes and analysis of Proposed referenced Standards" provided at the code development hearing.

Analysis: Review of proposed new standard indicated that, in the opinion of staff, the standard did comply with ICC standards criteria.

Committee Action: Approved as Modified

Modify proposal as follows:

BALLAST: Ballast is any item having weight that is used to hold or steady an object. In roofing, ballast comes in the form of Large aggregate ~~Stones (ASTM D448 #4 or larger)~~ or paver systems or light-weight interlocking paver systems and is used to provide uplift resistance for roofing systems that are not adhered or mechanically attached to the roof deck.

Chapter 35

ASTM
~~D448-03a Standard Classification for Sizes of Aggregate for Road and Bridge Construction~~

Committee Reason: The definition of ballast will help code users differentiate between aggregate used for wind uplift resistance versus other aggregate roofs. The modification changes "stone" to aggregate for consistency with the changed made in FS186-06/07.

Assembly Action: None

FS192–06/07

Committee Action: Approved as Submitted

Committee Reason: The proposal provides better coordination between the roof covering wind requirements in Section 1504 and Chapter 16 wind load requirements.

Assembly Action: None

FS196–06/07

Committee Action: Approved as Modified

Modify proposal as follows:

1504.4 Ballasted low-slope roof systems. Ballasted low-slope (roof slope < 2:12) single-ply roof system coverings installed in accordance with Sections ~~1507~~ 1507.12 and 1507.13 shall be designed in accordance with ~~Section 1504.8 and~~ ANSI/SPRI RP-4.

Committee Reason: The proposal clarifies the installation of ballasted low-slope roof systems by providing more specific section references. The modification retains the reference to Section 1504.8 for design because no reason was given to justify removing it.

Assembly Action: None

FS198–06/07

Committee Action: Approved as Submitted

Committee Reason: Substituting the term "aggregate" for "gravel and stone" clarifies these roof covering provisions.

Assembly Action: None

February 18 – March 1, 2008
Volume 1, Proposed Changes to the 2006 Edition
Structural

S1–07/08
1502.1

Proponent: Mike Ennis, SPRI, Inc.

Revise as follows:

1502.1 General. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

AGGREGATE (Supp). In roofing, crushed stone, crushed slag or water-worn gravel used for surfacing for roof coverings as defined in ASTM D 1863.

Reason: This code change proposal clarifies the definition of aggregate, tying it into a current IBC reference standard: ASTM D1863–03 Specification for Mineral Aggregate Used on Built-up Roofs.

Cost Impact: The code change proposal will not increase the cost of construction.

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

S2–07/08
1502.1

Proponent: Mike Ennis, SPRI, Inc.

Revise as follows:

1502.1 General. The following words and terms shall, for the purposes of this chapter and as used elsewhere in this code, have the meanings shown herein.

BALLAST (Supp). ~~Ballast is any item having weight that is used to hold or steady an object.~~ In roofing, ballast comes in the form of large stones or paver systems or light-weight interlocking paver systems and is used to provide uplift resistance for roofing systems that are not adhered or mechanically attached to the roof deck.

Reason: This code change will remove unnecessary language in the definition of ballast

Cost Impact: The code change proposal will not increase the cost of construction.

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

S12–07/08
1504.8

Proponent: Edwin Huston, National Council of Structural Engineers Association (NCSEA), representing NCSEA Code Advisory Committee – General Engineering Subcommittee

Revise as follows:

1504.8 (Supp) Aggregate. Aggregate used as surfacing for roof coverings and aggregate, gravel or stone used as ballast shall not be used on the roof of a building located in a hurricane-prone region as defined in Section 1609.2, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site.

Reason: When Section 1504.8 was added to the IBC by code change S1-03/04, it was the intent of the change that small gravel or aggregate used as surfacing on built-up roofs be prohibited. It was also the intent that larger gravel or stones used as ballast to hold down single–ply membrane roof coverings also be prohibited. With the addition of the definitions of "aggregate" and "ballast" by code change FS185-06/07 and FS186/06/07, respectively, it is necessary to modify Section 1504.8 to clarify that aggregate is prohibited as well as larger stones used as ballast.

Cost Impact: The code change proposal will not increase the cost of construction.

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

S13–07/08
1504.8, Table 1504.8

Proponent: Mike Ennis, SPRI, Inc.

1. Revise as follows:

1504.8 (Supp) Aggregate. Aggregate shall not be used on the roof of a building located in a ~~hurricane-prone~~ windborne debris region as defined in Section 1609.2~~, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site~~.

2. Delete table without substitution:

~~**TABLE 1504.8**~~
~~**MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR BUILDINGS WITH GRAVEL OR STONE ON THE ROOF IN AREAS OUTSIDE A HURRICANE-PRONE REGION**~~

~~BASIC WIND SPEED FROM FIGURE 1609 (mph)[b]~~	~~MAXIMUM MEAN ROOF HEIGHT (ft.)[a,c]~~		
	~~Exposure category[c]~~		
	~~B~~	~~C~~	~~D~~
~~85~~	~~170~~	~~60~~	~~30~~
~~90~~	~~170~~	~~35~~	~~15~~
~~95~~	~~75~~	~~20~~	~~NP~~
~~100~~	~~55~~	~~15~~	~~NP~~
~~105~~	~~40~~	~~NP~~	~~NP~~
~~110~~	~~30~~	~~NP~~	~~NP~~
~~115~~	~~20~~	~~NP~~	~~NP~~
~~120~~	~~15~~	~~NP~~	~~NP~~
~~Greater than 120~~	~~NP~~	~~NP~~	~~NP~~

~~a. Mean roof height in accordance with Section1609.2.~~
~~b. For intermediate values of ba sic wind speed, the height associated with the next higher value of wind speed shall be used, or direct interpolation is permitted.~~
~~c. NP = gravel and stone not permitted for any roof height.~~

Reason: This code change addresses the use of aggregate in the wind-borne debris regions as defined in Section 1609.2: **WIND-BORNE DEBRIS REGION.** Table 1504.8 which extends the limitation of aggregate on roofs beyond the hurricane prone region is deleted because the major concern with aggregate blow-off, if any, is in the wind borne debris region.

The current code is overly restrictive in it essentially bans the use of aggregate roofs (built-up roofs) in a major part of the US. However, these roofs have been used successfully for over a century in these wind zones and building heights. The severe limitation on the use of aggregate on roofs shown in the current (2006 and 2007 Supplement) IBC was based solely on a probability calculation and had no empirical evidence. While there is, of course, concern with aggregate blow-off in high wind conditions, actual experience shows that the concern about roof aggregate blow-off, if any, should only be in the wind borne debris regions.

The proposed restriction for aggregate roof systems for the wind borne debris regions is based on findings of the ASCE 7 Committee reflected in a distinction between Hurricane prone regions and the Wind Borne Debris Regions as illustrated in IBC Section 1609.2 as follows:

HURRICANE-PRONE REGIONS. Areas vulnerable to hurricanes defined as:
1. The U. S. Atlantic Ocean and Gulf of Mexico coasts where the basic wind speed is greater than 90 mph (40 m/s) and
2. Hawaii, Puerto Rico, Guam, Virgin Islands and American Samoa.

WIND-BORNE DEBRIS REGION. Portions of hurricane-prone regions that are within 1 mile (1.61 km) of the coastal mean high water line where the basic wind speed is 110 mph (48 m/s) or greater; or portions of hurricane-prone regions where the basic wind speed is 120 mph (53 m/s or greater; or Hawaii.

Cost Impact: The code change proposal will not increase the cost of construction.

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

S14–07/08
1502.1, 1504.8, Chapter 35 (New)

Proponent: Lorraine Ross, Intech Consulting Inc., representing the Asphalt Roofing Manufacturers Association

1. Revise definitions as follows:

SECTION 1502
DEFINITIONS

(Supp) AGGREGATE. In roofing, crushed stone, crushed slag or water-worn gravel used for surfacing for roof coverings, as defined in ASTM D 1863.

(Supp) BALLAST. ~~Ballast is any item having weight that is used to hold or steady an object.~~ In roofing, ballast comes in the form of large stones or paver systems or light-weight interlocking paver systems and is used to provide uplift resistance for roofing systems that are not adhered or mechanically attached to the roof deck.

2. Delete and substitute as follows:

~~**1504.8 (Supp) Aggregate.** Aggregate shall not be used on the roof of a building located in a hurricane-prone region as defined in Section 1609.2, or on any other building with a mean roof height exceeding that permitted by Table 1504.8 based on the exposure category and basic wind speed at the site.~~

1504.8 Aggregate. In wind-borne debris regions, a minimum of 50 percent of the total aggregate shall be embedded in the flood coat of bitumen. Aggregate shall comply with ASTM D 1863.

~~**TABLE 1504.8**~~
~~**MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR BUILDINGS WITH GRAVEL OR STONE ON THE ROOF IN AREAS OUTSIDE A HURRICANE-PRONE REGION**~~

~~BASIC WIND SPEED FROM FIGURE 1609 (mph)[b]~~	~~MAXIMUM MEAN ROOF HEIGHT (ft.)[a,d]~~		
	~~Exposure category[c]~~		
	~~B~~	~~C~~	~~D~~
~~85~~	~~170~~	~~60~~	~~30~~
~~90~~	~~170~~	~~35~~	~~15~~
~~95~~	~~75~~	~~20~~	~~NP~~
~~100~~	~~55~~	~~15~~	~~NP~~
~~105~~	~~40~~	~~NP~~	~~NP~~
~~110~~	~~30~~	~~NP~~	~~NP~~
~~115~~	~~20~~	~~NP~~	~~NP~~
~~120~~	~~15~~	~~NP~~	~~NP~~
~~Greater than 120~~	~~NP~~	~~NP~~	~~NP~~

~~a. Mean roof height in accordance with Section1609.2.~~
~~b. For intermediate values of ba sic wind speed, the height associated with the next higher value of wind speed shall be used, or direct interpolation is permitted.~~
~~c. NP = gravel and stone not permitted for any roof height.~~

3. Add standard to Chapter 35 as follows:

ASTM
D 1863-05 Standard Specification for Mineral Aggregate Used on Built-Up Roofs

Reason: This code change proposal clarifies the definition of aggregate, tying it into a current IBC reference standard: ASTM D1863—03 Specification for Mineral Aggregate Used on Built-up Roofs. This code change also delineates an safe appropriate use of aggregate roofs in wind borne debris regions as defined in IBC Chapter 1609.2.

The proposed language is taken from the 2004 Florida Building Code, High Velocity Hurricane Region where the ASCE 7 referenced wind Zone is 146 – 150 mph (3 sec. gust) and Exposure Category C. This area has recognized the advantages of built-up roofs, in terms of durability and fire test performance, and has developed requirements that allow its safe use. The last 15 years has proven the effectiveness of these requirements. There is no limitation on building height in this area and so the entire table has been deleted.

The current code is overly restrictive in it essentially bans the use of aggregate roofs (built-up roofs) in a major part of the US. However, these roofs have been used successfully for over a century in these wind zones and building heights. The severe limitation on the use of aggregate on built-up roofs shown in the current (2006 and 2007 Supplement) IBC was based solely on a probability calculation and had no empirical evidence. While there is, of course, concern with gravel blow-off in high wind conditions, actual experience shows that the requirements adopted by the Florida Miami-Dade County in its South Florida Building Code since Hurricane Andrew in 1992 and subsequent high wind events has proven to be effective in the use of this highly versatile roofing system.

The proposed requirements for aggregate roof systems for the wind borne debris regions is based on findings of the ASCE 7 Committee reflected in a distinction between Hurricane prone regions and the Wind Borne Debris Regions as illustrated in IBC Section 1609.2 as follows:

HURRICANE-PRONE REGIONS. Areas vulnerable to hurricanes defined as:

1. The U. S. Atlantic Ocean and Gulf of Mexico coasts where the basic wind speed is greater than 90 mph (40 m/s) and
2. Hawaii, Puerto Rico, Guam, Virgin Islands and American Samoa.

WIND-BORNE DEBRIS REGION. Portions of hurricane-prone regions that are within 1 mile (1.61 km) of the coastal mean high water line where the basic wind speed is 110 mph (48 m/s) or greater; or portions of hurricane-prone regions where the basic wind speed is 120 mph (53 m/s or greater; or Hawaii.

The concern about roof aggregate blow-off, if any, should be in the wind borne debris regions. This code requirement has been used in the Miami-Dade county area for over 15 years and has a proven track record of success.

Cost Impact: The code change proposal will not increase the cost of construction.

Analysis: A review of the standard proposed for inclusion in the code, ASTM D 1863, for compliance with ICC criteria for referenced standards given in Section 3.6 of Council Policy #CP 28 will be posted on the ICC website on or before January 15, 2008.

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

S15–07/08

Table 1504.8, 1602.1 (New); IRC R202

Proponent: Philip Brazil, Reid Middleton, Inc., representing himself

THESE PROPOSALS ARE ON THE AGENDA OF THE IBC STUCTURAL AND IRC BUILDING/ENERGY CODE DEVELOPMENT COMMITTEES AS 2 SEPARATE CODE CHANGES. SEE THE TENTATIVE HEARING ORDERS FOR THESE COMMITTEES.

PART I – IBC STRUCTURAL

1. Revise table as follows:

TABLE 1504.8
MAXIMUM ALLOWABLE MEAN ROOF HEIGHT PERMITTED FOR BUILDINGS WITH GRAVEL OR STONE ON THE ROOF IN AREAS OUTSIDE A HURRICANE-PRONE REGION

BASIC WIND SPEED FROM FIGURE 1609 (mph)[b]	MAXIMUM MEAN ROOF HEIGHT (ft.)[a,d]		
	Exposure category[c]		
	B	C	D
85	170	60	30
90	170	35	15
95	75	20	NP
100	55	15	NP
105	40	NP	NP
110	30	NP	NP
115	20	NP	NP
120	15	NP	NP
Greater than 120	NP	NP	NP

a. ~~Mean roof height in accordance with Section1609.2.~~
~~b~~. For intermediate values of basic wind speed, the height associated with the next higher value of wind speed shall be used, or direct interpolation is permitted.
b~~c~~. NP = gravel and stone not permitted for any roof height.

2. Add new definition as follows:

SECTION 1602
DEFINITIONS AND NOTATIONS

MEAN ROOF HEIGHT. The vertical distance from grade plane to the average of the roof eave height and the height of the highest point on the roof surface, except that, for roof angles no greater than 10 degrees (0.174 rad), the mean roof height shall be the vertical distance from grade plane to the roof eave height.

PART II – IRC BUILDING/ENERGY

Revise as follows:

SECTION R202
DEFINITIONS

MEAN ROOF HEIGHT. The vertical distance from grade plane to the average of the roof eave height and the height ~~to~~ of the highest point on the roof surface, except that, ~~eave height shall be used for roof angle of less than or equal to~~ for roof angles no greater than 10 degrees (0.18 rad), the mean roof height shall be the vertical distance from grade plane to the roof eave height.

Reason: There are several locations in the IBC where mean roof height is specified. Refer to Sections 1504.8, 1609.1.2 and 1609.4.3; and Tables 1504.8, 1507.3.7, 1609.1.2 and 2308.10.1. The IBC, however, does not define it. A definition was in 2003 IBC Section 1609.1.2 but it was deleted by Proposal S32-04/05-AM. This proposal restores the definition. The proposed definition is similar to the definition in Section 6.2 of ASCE 7-05 except it corrects the inadvertent omission in that definition of specifying what the mean roof height is measured from, which is grade plane in the proposed definition.

"Grade plane" was chosen for the definition over "grade" because of approved Proposal G44-04/05-AM, which successfully established the distinction between "grade plane" as a measurement of the height and number of stories of a building above the finished ground surface and "grade" as a measurement of the height of a component of the building above the finished ground surface. Grade plane is an imaginary horizontal reference plane representing the weighted average of the finished ground surface adjoining the building at its perimeter. The grade plane of each building is located at a single, unique elevation. Grade, however, is not imaginary but is the actual finished ground surface adjoining the building at its perimeter, which varies in elevation with the ground surface. Note that, in each case where "mean roof height" is specified in the IBC, the application is to a building or structure, not a component of a building or structure.

Footnote (a) of Table 1504.8 is deleted in coordination with the proposed definition.

Cost Impact: The code change proposal will not increase the cost of construction.

PART I – IBC STRUCTURAL

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF

PART II – IRC BUILDING/ENERGY

Public Hearing: Committee: AS AM D
Assembly: ASF AMF DF