# Three-Tab Shingle Performance During Hurricane Ivan, 2004







## By David Rash, RRC, Assoc. AIA

n order to have verifiable, replicable results, the evaluation of material performance in roofing systems is usually dependent upon controlled laboratory testing. Laboratory tests are most often conducted using new materials that have been installed in strict conformance with manufacturers' guidelines. While roofing systems are usually installed with new materials, installation can often be at variance with manufactur-

ers' guidelines. This is particularly true of threetab, asphalt-composition shingles, one of the most popular steep-slope roofing materials – especially during the latter half of the 20th century.

Hurricane Ivan's rampage through the southeastern portion of the United States in September 2004 provided an opportunity to observe the real-world performance of this ubiquitous roofing material as it relates to age. In the city of Mobile, Alabama, an 18-building housing

#### Three-tab, Asphalt-composition Shingles

Although widely used during the latter half of the 20th century and still quite popular today, three-tab, asphalt-composition shingles are a relatively recent roofing product.

Built-up or composition roofing, from which asphalt-composition shingles were derived, developed in the late 18th and early 19th centuries. One prominent historic example was the use of an application of available since antiquity as a waterproofing agent, widespread use of asphalt did not occur until the development of the petroleum industry during the second half of the 19th century. Initially, asphalt-composition shingles were hand cut from manufactured sheets of "stone-surfaced," rolled roofing. This first occurred in 1903 by Herbert M. Reynolds, a roofing manufacturer and contractor of Grand Rapids, Michigan. By 1906, Bird & Son had introduced a



Photo 1 – Typical configuration and condition of building structure within the housing complex.

complex had shingles from three distinct installations with a similar level of workmanship prevailing throughout the complex (*Photo 1*). That there was a correlation between age and performance was not a surprise. What was unexpected was how well the shingles performed, despite their age and poor installation.

pine tar to canvas sheeting for the low-slope roofs of the Octagon House (1800) in Washington, D.C. More common after 1847 was the use of coal tar with heavy paper sheeting.<sup>1</sup> Composition shingles, however, required a more solid waterproofing agent than either pine tar or coal tar.

Although natural asphalt had been

notched, two-tab shingle. This incremental innovation was soon followed by the now familiar three-tab shingle, as well as a variety of other shapes and sizes. All major roofing manufacturers offered a 12-inch x 36inch, three-tab shingle by 1935, composed of asphalt, reinforcing felt, and granular surfacing. After World War II, this became



*Photo 2 (left) – The long wing of Building 1 had an "old" shingle roof, typical of nine buildings in the complex.* 

Below: Photo 4 – The long wing of Building 16 had a "moderately old" shingle roof, typical of five buildings in the complex.

the dominant composition shingle type, with minor changes such as the transition from organic felt to fiberglass mat for reinforcement and from English dimensions to metric dimensions (0.33 meter x 1.0 meter).<sup>2</sup>

#### Hurricane Ivan

On September 16, 2004, Hurricane Ivan made landfall near Gulf Shores, Alabama. Widespread property damage occurred along the storm's path. The Mobile area was hit with peak wind gusts ranging from 74 mph at WKRG Studios in the downtown area to 105 mph at Battleship Park on Mobile Bay. Rainfall likewise varied according to location, with Andalusia, Alabama, recording nearly 10 inches, while Bates Field recorded slightly more than 5-1/2 inches, with the heaviest rainfall occurring east of Ivan's center as it moved northward into central Alabama.

#### **18-building Housing Complex**

The housing complex was comprised of 18 buildings that contained 30 one-bed-

room and 53 two-bedroom residential units. The complex was reportedly constructed in 1972 and included a storage building located near the center of the complex, which

was no longer standing. Exterior walls were constructed of concrete-masonry units (CMU). Interior walls were constructed of wood framing with plaster finish. The roofs were constructed of wood trusses and sheathed with 1 x 6 wood decking, over which were installed felt underlayment and three-tab asphalt-composition shingles. A roof slope of 5:12 was generally provided.

Damage to the housing complex resulted from two primary causes. High winds from Hurricane Ivan caused some damage to the shingles and removed some roofing

components from the buildings. The building complex was also abandoned and vandalized some two years prior to the arrival of Hurricane Ivan. Typical examples of vandalism were plumbing fixtures, electrical wiring, mailboxes,



light fixtures, window frames and glazing, and lead flashings at the pipe penetrations through the roofs, as well as charred framing members and interior finishes. Curiously, a 19th building – used as a storage facility for the complex – had existed on the site as late as November 15, 2004, but had disappeared without a trace by January 25, 2005.

The total ground area covered by buildings was approximately 48,971 square feet. The total sloped area of roofs covered with three-tab, asphalt-composition shingles was approximately 58,535 square feet. The ages of the shingled roofs were unknown. Topical observation suggested that some of the roofs might have been part of the original (30+ year construction) and are noted in this paper as "old" (see Photo 2). Some shingles were definitely installed recently (less than five years agp), and are noted in this paper as "recent" (see Photo 3). Other shingles were likely of less recent installation but not original construction (10 to 15 years old), which are noted in this paper as "moderately old" (Photo 4).

The determination as to whether missing or damaged shingle tabs were due to the recent hurricane event or were pre-existing due to either age or vandalism was based upon the condition of nail heads exposed to



*Photo 3 – The center wing of Building 12 had a "recent" shingle roof typical of four buildings within the complex.* 



Above: Photo 5 – Nails were underdriven and located too high with the "old" shingle roof installation on Building 10.

weather. Lightly rusted or non-rusted nail heads would suggest recent exposure; heavily rusted nail heads would suggest exposure prior to the hurricane. In addition, in some areas where shingles were recently lost due to a wind event, installation deficiencies undoubtedly contributed to the shingle loss. In particu-

lar, under-driven nails or nails located so high as to secure only one layer of shingles, rather than the intended two layers, resulted in roofs susceptible to wind damage (*Photos 5, 6,* and 7).



Above: Photo 6 – Nails were underdriven and located too high with the "moderately old" shingle roof installation on Building 2.

#### Wind Uplift

As most roof consultants are aware, wind damage to roofs occurs due to multiple reasons, including poor installation, wind uplift exceeding the design specifica-



*Photo* 7 – *Nails were underdriven and located too high with the "recent" shingle roof installation on Building 15.* 

tions, and age of the system. roofing Wind uplift occurs when the air pressure inside the building is greater than the air pressure outside the building. As wind passes over the building, there is a decrease in external air pressure and there is a corresponding increase in air pressure differential between the inside and outside of the building.



## RCI, Inc. 800-828-1902 www.rci-online.org



As the internal air pressure tries to equalize itself with the external air pressure, the resulting force, identified as wind uplift, attempts to lift the roof off the building as it tries to return to equilibrium.

Wind uplift can also occur in areas of the roof due to wind drag and air velocity. This creates a situation where shingles are pulled from the roof deck. This phenomenon occurs on roofs even if steps are taken to prevent air infiltration through the deck. Most of the buildings at the housing complex, however, no longer had their end gable louvers, allowing more air infiltration into the attic spaces of the buildings than would normally occur with well-maintained buildings.

In addition to the air pressure inside a building, there are several other factors that

can significantly increase wind uplift forces, such as the building's position relative to wind direction and the ground terrain adjacent to the building. These factors create turbulence or vortices (possibly both) that can magnify existing uplift forces.

Wind uplift likely caused the most sig-

Left: Photo 8 – The most extensive wind loss of shingles occurred near the roof perimeter and with the "old" shingles, such as on Building 13.

nificant damage to the shingled roofs outside of vandalism and age. Uplift forces near the perimeter of the roof structures were sufficient to remove shingle tabs from portions of some roofs, particularly the older ones (*Photos 8*, 9 and 10).

#### Assessment

Based on our site visits and visual observations, it is our opinion that on September 16, 2004, Hurricane Ivan caused the damage discussed in the observations

portion of this report. In determining what might be appropriate in regards to repairs, we have based our suggestions for repairs on the types of maintenance repairs previously performed at the site. In regard to the roofs, many existing roofs have had damaged or lost shingle tabs replaced by indi-





Above: Photo 9 – Less extensive wind loss of shingles occurred with the "moderately old" shingles, primarily near the roof perimeter, such as on Building 18.

*Photo* 10 – *Very little wind loss of shingles occurred with the* "recent" *shingles*, *such as on Building* 15.



*Photo 11 – Despite overexposure, repaired portions of "old" shingle roofs performed well during the hurricane, such as these repairs on Building 13.* 

vidual shingle tabs rather than full roof replacement (*Photo 11*). Only Building 3 (which suffered structural damage from a fallen tree, *Photo 12*) sustained sufficient damage to warrant full replacement of the shingles on the roof. Only three of the 18

existing buildings suffered more than 1 percent loss of covering from Hurricane Ivan. Even with these buildings, the loss of shingles was less than 5%: Building 13, 4.53%; Building 11, 2.55%; and Building 17, 1.95%. As might be expected, each of these



Photo 12 – Although the "old" shingles on Building 3 suffered very little direct wind damage, structural damage from this fallen tree would necessitate replacement of the shingles.



RCI, Inc. 800-828-1902 www.rci-online.org



*Figure 1 – The "old," "moderately old," and "recent" shingle roofs were each widely distributed throughout the housing complex, as can be seen with the project site plan.* 

three buildings had "old" shingles (see *Figure 1*). For a complete breakdown of shingle loss per building, see *Table 1* for a building breakdown and *Table 2* for unit breakdown.

#### Summation

In summary, this housing complex had easily suffered as much damage from vandalism and age as it had from the recent hurricane event, if not more so. Considering that the old variegated brown shingles were likely in excess of 30 years old when Hurricane Ivan passed through Mobile, and that most three-tab, asphalt-composition shingles have a warranted life expectancy of 25 years, and virtually none have a warranted service life expectancy in excess of 30 years, it was remarkable that there was not more hurricane-related damage from wind uplift. This was even more remarkable given some of the installation deficiencies that were observed where wind loss had occurred – the most notable deficiencies being nails placed too high or missing altogether. These particular deficiencies resulted in shingles with too few fasteners to adequately resist wind uplift.

Considering how well the various shingle installations had performed at Mobile, Alabama, this paper should not be viewed as an endorsement of poor workmanship and/or inadequate maintenance. The outstanding shingle performance under adverse conditions at Mobile does suggest three-tab asphalt-composition shingles are a highly viable steep-slope roofing material, even if some consider this product to have less street appeal than its architectural brethren. It also suggests that proper installation and adequate maintenance might have obviated an insurance loss claim.

#### Acknowledgements

The author would like to acknowledge the assistance of fellow co-workers at Madsen, Kneppers and Associates, Inc., on the investigative project that resulted in this paper: Gary R. Foster, of the San Diego, California, office; Randal A. Goetz (project manager) and Brad Vesperman of the Chicago, Illinois, office; and David A. VanDerostyne, PE, of the Seattle, Washington, office (engineer of record). Chris Kneppers, RRC, of the Atlanta, Georgia, office reviewed a preliminary version of this paper.

	Root Area	Ridge Length	Damaged shingle tabs		Damaged ridge shingles		Damaged Area (SF)		Damage percentage	
			Pre-existent	Hurricane	Pre-existent	Hurricane	Pre-existent	Hurricane	Pre-existent	Hurricane
Building 1	3,687 SF	118.3333 LF	36	1	0	0	15.00	0.42	0.41	0.01
Building 2	2,059 SF	66.3333 LF	33	5	0	0	13.75	2.08	0.67	0.10
Building 3	1,493 SF	47.8333 LF	13	365	0	8	5.42	155.42	0.36	10.41
Building 4	2,059 SF	66.3333 LF	42	2	1	0	17.92	0.83	0.87	0.04
Building 5	2,198 SF	70.5 LF	12	6	0	0	5.00	2.50	0.23	0.11
Building 6	3,517 SF	113 LF	66	28	19	0	35.42	11.67	1.01	0.33
Building 7	1,493 SF	47.8333 LF	2	13	0	0	0.83	5.42	0.06	0.36
Building 8	3,517 SF	113 LF	44	71	0	2	18.33	30.42	0.52	0.86
Building 9	3,754 SF	120.8333 LF	26	7	0	0	10.83	2.92	0.29	0.08
Building 10	3,687 SF	118.3333 LF	20	55	0	0	8.33	22.92	0.23	0.62
Building 11	3,518 SF	113 LF	2	206	3	9	2.08	89.58	0.06	2.55
Building 12	4,303 SF	138.1667 LF	4	0	0	0	1.67	0.00	0.04	0.00
Building 13	2,198 SF	70.5 LF	37	239	9	0	19.17	99.58	0.87	4.53
Building 14	5,467 SF	175.5 LF	66	118	0	0	27.50	49.17	0.50	0.90
Building 15	6,054 SF	195.3333 LF	36	2	0	0	15.00	0.83	0.25	0.01
Building 16	4,019 SF	129 LF	0	35	0	0	0.00	14.58	0.00	0.36
Building 17	1,493 SF	47.8333 LF	0	70	0	0	0.00	29.17	0.00	1.95
Building 18	4,019 SF	129 LF	3107	60	100	0	1336.25	25.00	33.25	0.62
Storage Building	SF	LF	54 1350	862	6220	1 CARS	0.00	0.00	Corners a	- See .
	58,535 SF	LF	3546	1283	132	19	1532.50	542.50	2.62	0.93
Unit	Roof Area	Ridge Length	Damaged shingle tabs		Damaged ridge shingles		Damaged Area (SF)		Damage percentage	
Location		10.0	Pre-existent	Hurricane	Pre-existent	Hurricane	Pre-existent	Humicane	Pre-existent	Hurricane

Table 1 – Overall breakdown of damage by building.

CONSTRUCT         And Set         Part Set	Unit	Roof Area Ridge Length		Damaged shingle tabs		Demaged ridge shingles		Damaged Area (SF)		Damage percentage	
The G-LINE C         TO G         C         TO G         C         TO G         CO C         C <thc< th="">         C         <thc< th="">         C</thc<></thc<>	Plan 1.1 but A	745.55	PERMIT	Pre-existent	Putticarie	PT4-4XIGIBIS	Putticatie	PTH-ACISIANI	Processie	Pre-existent	Plumcarie
Big Lunc         Product         <	Rido 1-Unit R	710 SE	22.75 LF	7	ő	ŏ	ő	2.92	0.00	0.41	0.00
Big Lunc         7 10 gP         25.833 LP         6         0         0         2.560         0.000         0.241           Big Long         777 gP         25.1677 LP         1         3         0         0         4.560         0.000         0.241           Big Long         777 gP         25.1677 LP         1         3         0         0         2.4642         0.861         0.864           Big Long         777 gP         25.1677 LP         7         0         0         0         0.250         0.000	Bide 1-Unit C	710 SF	22.75 LF	8	0.70	ő	ň	250	3.25	0.35	0.53
Big _blink         T7 B         25.1987         U         B         0         0         2.200         0.00         0.52           Big _blink         C         0.00         0         4.59         0.75         0.52           Big _blink         C         0.00         0         2.175         0.00 <th0.00< th=""> <th0.00< td="" th<=""><td>Bidg 1-Unit D</td><td>743 SF</td><td>23,8333 LF</td><td>6</td><td>ò</td><td>ō</td><td>ö</td><td>2.50</td><td>0.00</td><td>0.34</td><td>0.00</td></th0.00<></th0.00<>	Bidg 1-Unit D	743 SF	23,8333 LF	6	ò	ō	ö	2.50	0.00	0.34	0.00
	Bidg 1-Unit E	779 SF	25.1667 LF	6	0	0	0	2.50	0.00	0.52	0.00
bidg	Blog 2-Unit A	779 SF	25.1667 LF	11	3	0	0	4.58	1.25	0.59	0.16
Bing Junit G.         641 2         20147 J.         74         25         24.2         0.83         0.66           Bing Junit G.         746         27         25.1         0         0         0         252         0.50         0.58           Bing Junit G.         746         27         25.1         0         0         0         252         0.50         0.58           Bing Junit G.         779         27         25.1         0         0         1.55         0.51         1.55         0.17           Bing Junit G.         779         27         25.1         77         7         0         0         1.55         0.51         1.55         0.17           Bing Junit A.         770         27         2.5         0         0         7.64         2.52         0.51         1.55         0.5         0         1.56         0.50         1.55         0.50         1.55         0.5         0         7.64         2.52         0.51         1.55         0.5         1.55         0         1.55         0.51         1.55         0.55         1.55         0         1.55         0.50         1.55         0.55         1.55         0.55         1.55	Bidg 2-Unit B	630 SF	20.9167 LF	9	2	0	0	3.75	0.83	0.59	0.13
Biog Junit A.         Tet 2         23 Hort J. F         T         M60         0         6         222         198.2         2.2         198.2         19	Bidg 2-Unit C	641 SF	20.9167 LF	13	0	0	2	5.42	0.83	0,85	0.13
Bag Juliat B, Tri SF 23, Bir J, E 6, 0, 0, 0, 220, 0, 0, 0, 33 Bag Juliat C, Tri SF 23, Bir J, E 5, 0, 0, 0, 125, 0, 0, 0, 125 Bag Juliat C, Tri SF 23, Bir J, E 3, 0, 0, 0, 125, 0, 0, 0, 125 Bag Juliat C, Tri SF 22, Bir J, E 3, 0, 0, 0, 125, 0, 0, 0, 125 Bag Juliat C, Tri SF 22, Bir J, E 3, 0, 0, 0, 125, 0, 0, 0, 125 Bag Juliat C, Tri SF 22, Bir J, E 3, 0, 0, 0, 125, 0, 0, 0, 125 Bag Juliat C, Tri SF 22, Bir J, E 3, 0, 0, 0, 125, 0, 0, 125 Bag Juliat C, Tri SF 24, 26, 24, 24, 24, 24, 24, 24, 24, 24, 24, 24	Bidg 3-Unit A	746 SF	23.9167 LF	7	365	0		2.92	155.42	0.39	20.83
	Bldg 3-Unit 8	747 SF	23.9167 LF	6	0	0	0	2.50	0.00	0.55	0.00
Bing 4 Lint 7         Bing 5 Lint 7         Pin 2         Sint 7         Si	Bldg & Unit A	643 SF	20.5833 LF	15	0	0	0	6.25	0.00	0.98	0.00
Bigs Lufric         777         52         23.467         10         0         1.33         1.13           Bigs Lufric         770         52         23.867         1.33         0         0         1.33         1.33         0.33         1.13           Bigs Lufric         774         52         23.8133         11         1.35         0.33         0         0         1.35         0.33         0         0         1.35         0.34           Bigs Lufric         774         52         2.4610         1         0         0         2.56         1.35         0.34           Bigs Lufric         777         7         0         0         0         2.56         1.35         0.34           Bigs Lufric         776         52         2.54         77         7         0         0         0         0.55         0.56	Bidg 4-Unit B	630 SF	20.5833 LF	6	0	0	0	2.50	0.00	0.39	0.00
Big Juhr         Prop         Prop<         Prop<<	Bidg 4-Unit C	779 SF	25.1667 LF	20	- 2 -	1	0	8.75	0.83	1.12	0.11
Bing Linket         Trie SP         Z2233 LF         3         0         0         0         1         125         1500         0.11           Bing Linket         Trie SP         Z2333 LF         1         3         0         0         0         125         1500         0.01           Bing Linket         Trie SP         Z43 LF         171         23         0         0         0         752         250         150         0.01           Bing Linket         Trie SP         Z43 LF         1         0         4.55         6.42         0.62         0.62         0.63         6.60         6.113           Bing Linket         Trie SP         Z3 Bing LF         2         1         1         0         0.63         6.60         6.113           Bing Linket         Trie SP         Z4 Bing LF         5         16         0         0         0         0.33         1.55         0.44           Bing Linket         Trie SP         Z4 Bing LF         15         21         0         0         0         0         0.33         1.57         0.44           Bing Linket         Trie SP         Z4 Bing LF         15         0         0         0 <td>Bidg 5-Unit A</td> <td>740 SF</td> <td>23.8333 LF</td> <td>3</td> <td>3</td> <td>0</td> <td>0</td> <td>1.25</td> <td>1.25</td> <td>0,17</td> <td>0,17</td>	Bidg 5-Unit A	740 SF	23.8333 LF	3	3	0	0	1.25	1.25	0,17	0,17
Bing Link         Ath         D <thd< th="">         D         <thd< th="">         D         D         <thd<< td=""><td>Blog 5-Unit 8</td><td>714 5</td><td>22.8333 LF</td><td>3</td><td>0</td><td>0</td><td>0</td><td>1.25</td><td>0.00</td><td>0.18</td><td>0.00</td></thd<<></thd<></thd<>	Blog 5-Unit 8	714 5	22.8333 LF	3	0	0	0	1.25	0.00	0.18	0.00
Bing Link         / / 28         / 2.5         / 1.5         / 0         / 0         / 1.08	Illing 5-Unit G	744 22	23,8333 17	8	3	0	0	250	1.25	0.54	0.17
Bill O UNITE       ALE DF       ALE DF<	Blag & UNITA	779 35	25.166/ LP	140	1		0	7.08	2.92	0.91	0.37
Description         Description <thdescription< th=""> <thdescription< th=""></thdescription<></thdescription<>	Blog & Unit B	192 35	24.9 LP	- 22		8	8	1.08	0.00	1.25	0.00
Design Link         Design Link <thdesign link<="" th=""> <thdesign link<="" th=""></thdesign></thdesign>	Bidg 6-Unit C	000 38	19,4107 UF	12		0	0	1.94	2.00	1.31	0.41
Bigs Lights         Constraint         Constraint <thconstraint< th="">         Constraint         Constra</thconstraint<>	Blag 6-Unit D	000 58-	1904107 LF	1			0	0.25	0.85	1,05	0,14
Bigs 1.20118         TYP SF         2.21987 b         5         6         1         0         0         0.05         0.22         0.00           Bigs 1.1017 C         Dist 1.101 C	Didg G-Unit E	104 07	201.5 LF	10	13	2	0	4.50	5.42	0.60	0.71
Biologic Livit B         Point B         Point B         Point B         Dot Size         Display B         Display B <thdisplay b<="" th="">         Display B         <th< td=""><td>Biog / Unit A</td><td>749 87</td><td>23.8107 15</td><td></td><td>14</td><td></td><td></td><td>0.00</td><td>0.42</td><td>0.00</td><td>0.07</td></th<></thdisplay>	Biog / Unit A	749 87	23.8107 15		14			0.00	0.42	0.00	0.07
The Frink         The C         The C         C <thc< th="">         C         C</thc<>	Blig Blight A	764 05	245167 LF	9	71	0	0	3.75	12.92	0.00	1.00
Table 1 bink C         Table 1 bink C <thtable 1="" bink="" c<="" th="">         Table 1</thtable>	Bide Billet B	808 55	10,4167.15	7		ő	ő	2.92	1.25	0.48	0.21
Bits         Division         Top SF         Top SF         Top SF         State         Division         Division <thdivision< th=""> <thdivision< <="" td=""><td>Bide B Unit C</td><td>606.55</td><td>19,4167 15</td><td>6</td><td>16</td><td>0</td><td>0</td><td>2.08</td><td>6.67</td><td>0.34</td><td>1.10</td></thdivision<></thdivision<>	Bide B Unit C	606.55	19,4167 15	6	16	0	0	2.08	6.67	0.34	1.10
Bits         Try         String         Try         String         Try         String         Try         String         Try         String         Try         String            String </td <td>Bide B-Unit D</td> <td>762 58</td> <td>245 15</td> <td>16</td> <td>21</td> <td>0</td> <td>2</td> <td>6.25</td> <td>9.50</td> <td>0.82</td> <td>1.26</td>	Bide B-Unit D	762 58	245 15	16	21	0	2	6.25	9.50	0.82	1.26
Bing Diamit A         TYD DF         22:107/U         0         4         0         0         23:33         1.67         0.43           Bing Diamit A         TYD DF         22:85:33         U         6         0         0         22:08         1.25         0.23           Bing Diamit A         TYD SF         22:85:33         U         6         0         0         0         1.67         0.00         0.238           Bing Diamit A         TYD SF         22:85:33         U         4         0         0         0         1.85         0.00         0.118           Bing Diamit A         TYD SF         22:85:33         U         4         0         0         0         1.85         0.00         0.118           Bing Diamit A         TYD SF         22:85:33         U         4         0         0         0         1.85         0.00         0.231           Bing Diamit A         TYD SF         23:85:37         U         1         3         0         0         0         1.85         0.00         0.231           Bing Diamit A         TYD SF         23:85:07 UF         1         3         1         0         0         0.00         0	Bito Billion F	779.55	25 1667 LE	10		ů i	â	417	2.50	0.53	0.32
Bits 0         Dum 0         Description         Description <thdescription< th=""> <thdescription< th=""> <thdescrip< td=""><td>Bidg S-Unit A</td><td>779.58</td><td>25.1067 LE</td><td>н</td><td>4</td><td>0</td><td>0</td><td>3.55</td><td>1.67</td><td>0.43</td><td>0.21</td></thdescrip<></thdescription<></thdescription<>	Bidg S-Unit A	779.58	25.1067 LE	н	4	0	0	3.55	1.67	0.43	0.21
Bits 0       Unit C       Trit SF       22 8333 UF       6       0       0       0       147       0.00       0.33         Bits 0       Unit T       Trit SF       23 833 UF       4       0       0       0       147       0.00       0.22         Bits 0       Unit T       Trit SF       23 803 UF       3       0       0       0       147       0.00       0.23         Bits 0       Unit T       23 803 UF       4       0       0       0       147       0.00       0.23         Bits 0       Unit T       22 8033 UF       4       0       0       0       147       0.00       0.23         Bits 0       Unit T       23 807 UF       1       4       0       0       0       0.60       6.75       0.00       0.17         Bits 0       Unit T       23 807 UF       1       3       0       0       0       0.00       6.75       0.00       0.	Bide 9-Unit B	740 SF	23 8333 LF	6		0	0	2.08	1.25	0.28	0.17
Bidg Duty D       772       27       25       107       1       0       0       0       1       100       0       0       1       0	Bidg 9-Unit C	714 SF	22,8333 LF	6	0	0	0	2.50	0.00	0.35	0.00
Big Buy Event         TYP SF         25 (197) LF         3         0         0         0         125         0.00         0.119           Big ToUMA B         774 SF         22 (193) LF         4         0         0         0         157         0.00         0.23           Big ToUMA C         772 SF         22 (193) LF         4         0         0         0         157         0.00         0.73           Big ToUMA E         777 SF         23 (197) LF         1         3         0         0         0         0.45         14.17         0.62           Big ToUMA E         777 SF         25 (197) LF         1         3         11         2         50.02         0.00         0.66           Big ToUMA E         779 SF         24 (197) LF         0         103         0         7         0.00         45.83         0.00           Big ToUMA E         794 SF         24.167         LF         0         10         0         0.00         10.00         10.00         10.00         0.00         0.00         0.00         0.00         0.00         10.00         10.00         10.00         0.00         0.00         0.00         0.00         10.00         10.0	Bldg 9-Unit D	742 SF	23.8333 LF	4	0	0	0	1.67	0.00	0.22	0.00
Blog TOLMAR         THA 05F         22 B333 LF         2         0         0         0         0.83         0.00         0.011           Blog TOLMAR D         TA4 25F         22 B333 LF         3         0         0         0         1.85         D.00         D.17           Blog TOLMAR D         TA4 25F         22 B187 LF         1         0         2         0         0         0.00         0.17         0.00         D.17           Blog TOLMAR D         TA4 25F         23 B167 LF         0         21         0         0         0.00         8.75         0.00         D.17           Blog TOLMAR D         TA7 5F         23 B167 LF         0         1         3         0         0         0         0.00         8.75         0.00           Blog TOLMAR D         TA5 LF         1         1         3         0         7         0.00 <t< td=""><td>Blog 9-Unit E</td><td>779 SF</td><td>25.1067 LF</td><td>3</td><td>0</td><td>0</td><td>0</td><td>1.25</td><td>0.00</td><td>0.16</td><td>0.00</td></t<>	Blog 9-Unit E	779 SF	25.1067 LF	3	0	0	0	1.25	0.00	0.16	0.00
Integ         Integ <th< td=""><td>Bidg 10-Unit A</td><td>740 SF</td><td>23.8333 LF</td><td>2</td><td>0</td><td>0</td><td>0</td><td>0.83</td><td>0.00</td><td>0.11</td><td>0.00</td></th<>	Bidg 10-Unit A	740 SF	23.8333 LF	2	0	0	0	0.83	0.00	0.11	0.00
Bidg ToLune C         742 SE         22 BB33 LF         3         0         0         0         1.25         0.00         0.17           Bidg TOLUNE E         747 SF         23.9167 LF         0         21         0         0         0.65         8.75         0.00           Bidg TOLUNE E         747 SF         23.9167 LF         1         48         0         0         0.65         8.75         0.00           Bidg TOLUNE E         747 SF         23.9167 LF         1         48         0         0         0.66         8.75         0.00           Bidg TOLUNE E         760 SF         19.4167 LF         0         6         0         0         0.00         2.66         0.00           Bidg TOLUNE A         779 SF         25.1007 LF         0         6         0         0         0.0	Bidg 10-Unit B	714 SF	22.8333 LF	4	0	0	0	1.67	0.00	0.23	0.00
Bidg 10-Unit D         744         58         23,9167 LF         11         34         0         0         4,68         14,17         0,62           Bidg 11-Unit A         779 SF         23,9167 LF         1         48         0         0         0,62         87,5         0,00           Bidg 11-Unit A         779 SF         23,65 LF         1         3         11         2         50,00         20,66         0,00         0,42         20,42         0,00           Bidg 11-Unit C         606 SF         19,4167 LF         0         103         0         7         0,00         46,83         0,00           Bidg 11-Unit C         606 SF         19,4167 LF         0         0         0         0         0,00         10,00         0,00 <t< td=""><td>filde 10-Unit C</td><td>742 EF</td><td>23.8333 LF</td><td>3</td><td>0</td><td>0</td><td>0</td><td>1.25</td><td>0.00</td><td>0.17</td><td>0.00</td></t<>	filde 10-Unit C	742 EF	23.8333 LF	3	0	0	0	1.25	0.00	0.17	0.00
Bidg 10-Link E         747 SF         22.967 LF         0         21         0         0         0.00         8.75         0.00           Bidg 11-Link B         762 SF         23.167 LF         1         33         11         22         500         2.068         0.00         4.653         0.00           Bidg 11-Link B         762 SF         23.45 LF         1         33         11         2         5.00         2.06         0.06           Bidg 11-Link D         666 SF         19.4167 LF         0         6         0         0         0.00         2.50         0.00           Bidg 11-Link D         764 SF         24.5 LF         0         77         0         0         0.00         0.	Bidg 10-Unit D	744 SF	23.9167 LF	11	34	0	0	4.58	14.17	0.62	1.90
Blog 11-Link A Blog 11-Link B Blog 11-Link C Blog 1	Bidg 10-Unit E	747 SF	23.9167 LF	0	21	0	0	0.00	8.75	0.00	1.17
Bidg 11-Line B Bidg 11-Line C Bidg 11-Line C Bidg 11-Line C Bidg 11-Line D Bidg 12-Line C Bidg 14-Line C Bidg 1	Bldg 11-Unit A	779 SF	25.1667 LF	1	49	0	0	0.42	20.42	0.05	2.62
Bidg 11-Link C         606 SF         11 8/4167 LF         0         103         0         7         0.00         44.83         0.00           Bidg 11-Link E         794 SF         124.5 LF         0         37         0         0         0.00         15.42         0.00           Bidg 11-Link E         794 SF         23.65 LF         0         37         0         0         0.00<	Bidg 11-Unit B	762 SF	24.5 LF	1	3	11	2	5.00	2.08	0.66	0.27
Big 11-Unit D 600 3F 119-4167 LF 0 6 6 0 0 0.000 2.50 0.000 Big 12-Unit D 775 5F 23.5 LF 0 37 0 0 0.000 0.000 0.000 0.000 Big 12-Unit D 775 5F 23.5 LF 0 0 0 0 0 0 0 0.000 0.000 0.000 Big 12-Unit D 600 3F 15.4167 LF 0 0 0 0 0 0 0 0 0.000 0.000 0.000 Big 12-Unit E 754 3F 23.5 LF 0 0 0 0 0 0 0 0 0.000 0.000 0.000 Big 12-Unit E 754 3F 23.5 LF 0 0 0 0 0 0 0 0.000 0.000 0.000 Big 12-Unit E 754 3F 23.5 LF 0 0 0 0 0 0 0 0.000 0.000 0.000 Big 12-Unit E 754 3F 23.5 LF 0 0 0 0 0 0 0.000 0.000 0.000 Big 12-Unit E 754 3F 23.5 LF 1 0 0 0 0 0 0 0.000 0.000 0.000 Big 12-Unit E 754 3F 23.5 LF 1 0 0 0 0 0 0 0.000 0.000 0.000 Big 12-Unit E 754 3F 22.8333 LF 2 0.03 0 0 0 0.000 0.000 0.000 Big 12-Unit E 754 3F 22.8333 LF 2 0.03 0 0 0 0.000 0.000 0.000 Big 12-Unit E 754 3F 22.8333 LF 22 119 B 0 0 12.82 4858 1.81 Big 13-Unit A 744 3F 22.8333 LF 12 46 0 0 5.000 19.177 0.78 Big 14-Unit A 601 3F 20.9933 LF 112 46 0 0 0 5.000 19.177 0.78 Big 14-Unit A 601 3F 20.9933 LF 12 46 0 0 0 5.000 19.177 0.78 Big 14-Unit A 601 3F 20.9933 LF 12 46 0 0 0 0.000 0.002 1.256 0.000 Big 14-Unit A 743 3F 22.554 LF 0 3 0 0 0 0.000 0.022 1.264 0.000 Big 14-Unit A 601 3F 20.9933 LF 12 46 0 0 0 0.000 0.042 1.266 0.000 Big 14-Unit A 601 3F 20.9933 LF 12 46 0 0 0 0.000 0.042 1.266 0.000 Big 14-Unit A 601 3F 20.9933 LF 12 46 0 0 0 0.000 0.042 1.266 0.000 Big 14-Unit A 743 3F 22.55 LF 0 3 1 0 0 0 0.000 0.42 0.000 0.422 0.000 Big 14-Unit A 743 3F 22.55 LF 0 3 1 0 0 0 0.000 0.42 0.000 0.42 Big 14-Unit A 743 3F 23.0533 LF 12 46 0 0 0 0.333 2.000 0.42 Big 14-Unit A 743 3F 23.0533 LF 1 3 0 0 0 0.000 0.42 0.000 0.52 Big 14-Unit A 743 3F 23.0533 LF 1 3 0 0 0 0.000 0.42 0.000 0.52 Big 14-Unit A 743 3F 23.0533 LF 1 0 1 0 0 0.000 0.42 0.000 0.52 Big 14-Unit A 643 3F 20.9933 LF 0 0 1 0 0 0.000 0.000 0.22 Big 14-Unit A 643 3F 20.9933 LF 0 0 0 0 0.000 0.000 0.000 0.000 0.000 Big 14-Unit A 775 3F 23.55 LF 0 0 0 0 0 0.000 0.000 0.000 0.000 0.000 Big 14-Unit A 645 3F 40.8333 LF 0 0 11 0 0 0 0.000 0.000 0.000 0.000 Big 14-Unit A 645 3F 40.8333 LF 0 0	Bidg 11-Linit C	606 SF	19.4167 LF	0	103	0	7	0.00	45.83	0.00	7.56
Blag 11-Link E 764 SF 24.5 UF 0 37 0 0 0.000 15.42 0.000 Blag 12-Link B 770 DF 24.5 UF 0 0 0 0 0 0 0.000 0.000 0.000 Blag 12-Link B 770 DF 24.5 UF 0 0 0 0 0 0 0.000 0.000 0.000 Blag 12-Link D 606 BF 18.4167 UF 0 0 0 0 0 0 0 0.000 0.000 0.000 Blag 12-Link D 606 BF 18.4167 UF 0 0 0 0 0 0 0 0.000 0.000 0.000 Blag 12-Link B 770 DF 25.1067 UF 0 0 0 0 0 0 0 0.000 0.000 0.000 Blag 12-Link B 770 DF 25.1067 UF 0 0 0 0 0 0 0 0.000 0.000 0.000 Blag 12-Link B 771 SF 25.1067 UF 0 0 0 0 0 0 0 0.000 0.000 0.000 Blag 12-Link B 771 SF 25.1067 UF 0 0 0 0 0 0 0 0.000 0.000 0.000 Blag 12-Link B 771 SF 25.1067 UF 0 0 0 0 0 0 0.000 0.000 0.000 Blag 12-Link B 771 SF 25.1067 UF 0 0 0 0 0 0.000 0.000 0.000 Blag 12-Link B 774 SF 22.8333 UF 12 46 0 0 5.600 19.177 0.78 Blag 13-Link B 774 SF 22.5383 UF 12 46 0 0 5.600 19.177 0.78 Blag 14-Link A 641 SF 20.5833 UF 12 46 0 0 5.600 19.177 0.78 Blag 14-Link B 770 SF 22.55 UF 0 1 1 0 0 0.000 0.000 0.022 Blag 14-Link B 770 SF 22.55 UF 0 1 1 0 0 0.000 0.020 0.020 Blag 14-Link A 740 SF 22.38333 UF 12 48 0 0 0 8.177 2042 1.24 Blag 14-Link C 742 SF 22.38333 UF 12 48 0 0 0 8.177 2042 1.24 Blag 14-Link C 742 SF 22.3833 UF 1 5.2 480 0 0 0.000 0.42 0.000 Blag 14-Link C 742 SF 22.3833 UF 1 5.2 48 0 0 0 0.000 0.42 0.000 Blag 14-Link C 742 SF 22.3833 UF 1 5.3 0 0 0.333 2.000 0.622 Blag 14-Link F 743 SF 22.5633 UF 1 5 0 0 1 0 0 0.000 0.42 0.000 Blag 14-Link F 743 SF 22.5633 UF 1 5 0 0 1 0 0 0.000 0.42 0.000 Blag 14-Link F 743 SF 22.5633 UF 4 0 0 0 0 1.677 0.000 0.236 Blag 15-Link A 778 SF 23.5633 UF 4 0 0 0 0 1.677 0.000 0.236 Blag 15-Link A 778 SF 23.5633 UF 0 0 1 0 0 0.000 0.42 0.020 Blag 15-Link F 600 SF 19.4167 UF 3 0 0 0 0 0.1677 0.42 0.220 Blag 15-Link F 600 SF 19.4167 UF 3 0 0 0 0 0.000 0.000 0.038 Blag 15-Link A 785 SF 23.5633 UF 0 0 0 0 0.000 0.000 0.038 Blag 15-Link A 785 SF 23.5675 UF 0 0 20 0 0 0.000 0.000 0.000 Blag 15-Link A 785 SF 23.5675 UF 0 0 20 0 0 0.000 0.000 0.000 0.000 Blag 15-Link A 785 SF 23.5677 UF 0 0 20 0 0 0.000 0.000 0.000 Blag 15-Link A 785 SF 23.	Bidg 11-Unit D	606 SF	19.4167 LF	0	6	0	0	0.00	2.50	0.00	0.41
Bidg 12 June A Bidg 12 June C Bidg 14 June B Bidg 14 June B Bidg 14 June C Bidg 1	Bidg 11-Unit E	764 SF	24.5 LF	0	37	0	0	0.00	15.42	0.00	2.02
Bidg 12 June B       Trig: DF       24.5. UF       0       0       0       0       0.000       0.000       0.000       0.000         Bidg 12 June D       606 BF       15 4467 UF       0       0       0       0       0.000       0.0	Blog 12-Unit A	779 SF	25.1667 LF	0	0	0	0	0.00	0.00	0.00	0.00
Bidg 12 Juns C 606 SF 1944167 IF 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Bidg 12-Unit B	762 SF	24.5 LF	0	0	0	0	0.00	0.00	0.00	0.00
Big 12 Units D 006 3F 119/167 JF 0 0 0 0 0 0 0 0.000 0	Bidg 12-Unit C	606 SF	10.4167 LF	0	0	0	0	0.00	0.00	0.00	0.00
Bidg 12-Unit E 745 3F 245 UF 4 0 0 0 0 1.87 0.00 0.22 Bidg 12-Unit E 776 3F 25 1007 U 0 0 0 0 0 0 000 0.00 0.00 Bidg 13-Unit A 740 5F 23 1333 UF 2 103 0 0 0 0.83 3475 0.11 Bidg 12-Unit C 744 3F 22 3133 UF 2 103 0 0 0 542 11,255 0.73 Bidg 14-Unit A 641 5F 20 5935 UF 12 46 0 0 562 0.00 Bidg 14-Unit B 716 3F 20 5935 UF 12 46 0 0 560 11,17 0.78 Bidg 14-Unit B 716 3F 23 5133 UF 2 48 0 0 0 7.00 3.33 1.11 Bidg 14-Unit C 744 3F 23 5133 UF 2 48 0 0 0 8.17 2042 1.24 Bidg 14-Unit B 716 3F 20 5935 UF 12 48 0 0 0 8.17 2042 1.24 Bidg 14-Unit C 742 3F 23 5133 UF 17 8 0 0 0 0.000 1.25 0.00 Bidg 14-Unit C 742 3F 23 5135 UF 12 48 0 0 0 0.000 0.42 0.00 Bidg 14-Unit C 742 3F 23 5135 UF 1 3 0 0 0 0.000 0.42 0.00 Bidg 14-Unit C 742 3F 23 5155 UF 1 3 0 0 0 0.42 0.00 Bidg 14-Unit C 740 3F 23 5155 UF 1 3 0 0 0 0.42 0.00 Bidg 14-Unit C 740 3F 23 5155 UF 1 3 0 0 0 0.42 0.00 Bidg 14-Unit C 740 3F 23 5155 UF 1 3 0 0 0 0.42 0.00 Bidg 14-Unit C 740 3F 23 5155 UF 1 3 0 0 0 0.42 0.00 Bidg 14-Unit C 740 3F 23 5157 UF 0 1 1 0 0 0.00 0.42 0.00 Bidg 14-Unit F 745 5F 23 5157 UF 0 1 1 0 0 0 0.00 0.42 0.00 Bidg 14-Unit F 745 5F 23 5157 UF 0 1 1 0 0 0 0.187 0.000 0.52 Bidg 15-Unit A 770 3F 23 1687 UF 8 0 0 0 0 3.33 0.500 0.52 Bidg 15-Unit A 770 3F 23 5167 UF 4 0 0 0 0 1.87 0.000 0.28 Bidg 15-Unit B 635 F 20 5933 UF 4 0 0 0 0 1.87 0.000 0.28 Bidg 15-Unit B 635 F 20 5933 UF 4 0 0 0 0 1.87 0.000 0.28 Bidg 15-Unit B 635 F 19.4167 UF 3 0 0 0 0.000 0.187 0.000 0.28 Bidg 15-Unit C 767 5F 245.01 4 1 0 0 0 1.87 0.000 0.28 Bidg 15-Unit A 775 F 19.45.01 4 0 0 0 0.000 0.452 0.02 Bidg 15-Unit C 767 5F 20.5933 UF 0 0 0 0 0.000 0.000 0.000 0.000 Bidg 15-Unit A 645 3F 40.8333 UF 0 0 11 0 0 0.000 0.28 0.000 0.23 Bidg 15-Unit A 645 3F 40.8333 UF 0 0 11 0 0 0.000 0.000 0.000 0.000 Bidg 15-Unit A 645 3F 40.8333 UF 0 0 10 0 0 0.000 0.000 0.000 0.000 Bidg 15-Unit A 775 F 23.50 UF 0 0 0 0 0.000 0.000 0.000 0.000 0.000 Bidg 15-Unit A 775 F 23.50 UF UF 0 0 0 0 0 0.000 0.000 0.000 0.000 Bidg 15-Unit A 775 F 23.50 UF UF 0 0 0 0 0 0.000 0.000 0.0	Bidg 12-Unit D	006 SF	10.4167 LF	0	0	0	0	0.00	0.00	0.00	0.00
Diag Tablet F         TW SF         DS 1000 D         0 <td>Bidg 12-Unit E</td> <td>764 SF</td> <td>24.5 LF</td> <td>4</td> <td>0</td> <td>0</td> <td>0</td> <td>1.67</td> <td>0.00</td> <td>0.22</td> <td>0.00</td>	Bidg 12-Unit E	764 SF	24.5 LF	4	0	0	0	1.67	0.00	0.22	0.00
Diag ISLAMA         Add DF         Disk         Disk <thdisk< th="">         Disk         Disk</thdisk<>	mag 12-Unit F	779.5#	25.1007 UF	0	0	0	0	0.00	0.00	0.00	0.00
Bag BJ Chint B / 14 SF 22 2833 DF 22 2119 B C 12 22 485 B 131 Big J S-Unit B / 14 SF 25 22 833 DF 12 24 6 0 0 5.00 19.17 0.79 Big J Lunk A 641 SF 25 25.933 UF 12 46 0 0 5.00 19.17 0.79 Big J Lunk B 030 SF 20.9933 UF 112 46 0 0 5.00 19.17 0.79 Big J Lunk C 742 SF 23.833 UF 12 24 40 0 0 0.00 1.17 20.42 1.24 Big J Lunk C 742 SF 23.833 UF 12 22 46 0 0 0 0.00 0.00 1.25 0.00 Big J Lunk F 745 SF 22.75 UF 0 1 1 0 0 0 0.00 0.42 1.75 0.00 Big J Lunk F 745 SF 23.833 UF 8 5 0 0 0 3.33 2.00 0.52 Big J Lunk C 769 3.33 UF 8 5 0 0 0 3.33 2.00 0.52 Big J Lunk F 745 SF 23.833 UF 8 5 0 0 0 3.33 2.00 0.52 Big J Lunk C 765 SF 23.53 UF 1 8 6 0 0 0 0.00 1.25 0.00 Big J Lunk F 745 SF 23.653 UF 8 6 3 0 0 2.256 1.25 0.39 Big J Lunk F 641 SF 20.9533 UF 8 5 0 0 0 1.67 0.00 0.24 Big J Lunk C 655 SF 23.6533 UF 8 6 0 0 0 0.167 0.00 0.24 Big J Lunk F 641 SF 20.9533 UF 8 5 0 0 0 0.00 1.67 0.00 0.24 Big J Lunk F 645 SF 20.9533 UF 8 5 0 0 0 0.00 1.67 0.00 0.24 Big J S-Unk B 635 SF 20.9533 UF 8 5 0 0 0 0 1.67 0.00 0.24 Big J S-Unk F 665 SF 19.4167 UF 8 0 0 0 0 1.67 0.00 0.24 Big J S-Unk C 655 SF 19.4167 UF 8 0 0 0 0 0.200 0.00 0.24 Big J S-Unk F 666 SF 19.4167 UF 3 0 0 0 0 0.200 0.00 0.24 Big J S-Unk F 666 SF 19.4167 UF 3 0 0 0 0 0.200 0.00 0.24 Big J S-Unk F 666 SF 19.4167 UF 3 0 0 0 0 0.200 0.00 0.23 Big J S-Unk F 666 SF 19.4167 UF 0 0 0 0 0.000 0.23 Big J S-Unk F 666 SF 19.4167 UF 0 0 0 0 0.000 0.23 Big J S-Unk F 666 SF 19.4167 UF 0 0 0 0 0.000 0.000 0.000 0.000 Big J S-Unk F 666 SF 19.4167 UF 0 0 0 0 0.000 0.000 0.000 0.000 Big J S-Unk F 666 SF 19.4167 UF 0 0 0 0 0.000 0.000 0.000 0.000 Big J S-Unk F 666 SF 19.4167 UF 0 0 0 0 0 0.000 0.000 0.000 0.000 Big J S-Unk F 666 SF 19.4167 UF 0 0 0 0 0 0.000 0.000 0.000 0.000 Big J S-Unk F 678 SF 23.5453 UF 0 0 0 0 0 0.000 0.000 0.000 0.000 Big J S-Unk A 765 SF 23.5453 UF 0 0 0 0 0 0.000 0.000 0.000 0.000 Big J S-Unk A 765 SF 23.5453 UF 0 0 0 0 0 0.000 0.000 0.000 0.000 Big J S-Unk A 765 SF 23.5453 UF 0 0 0 0 0 0 0.000 0.000 0.000 0.000 Big J S-Unk A 765 SF 23.5453 UF 0	lidg 13-Unit A	740 25	23 8333 D	2	103	0	0	083	38.75	0.11	0.24
Bing Dotatic         7.44 3F         23.8033 DF         13         27         0         0         5.42         11,25         0.73           Bing 14-Unit B         GSB 0F         20.6933 UF         112         46         0         0         5.00         1517         0.78           Bing 14-Unit B         GSB 0F         20.6933 UF         117         8         0         0         7.00         3.33         1.11           Bing 14-Unit D         7710 SF         22.75 UF         0         3         0         0         0.000         1.25         0.000           Bing 14-Unit D         7710 SF         22.75 UF         0         1         0         0         0.000         0.422         1.75         0.000           Bing 14-Unit D         7710 SF         22.75 UF         0         1         3         0         0         0.422         1.75         0.000           Bing 14-Unit B         GS3 S2         20.6933 UF         1         3         0         0         2.50         1.25         0.333         0.00         0.333         2.000         0.52           Bing 15-Unit B         GS3 S2         25.6633 UF         4         0         0         0         1.87<	Bidg 13-Unit B	714 SF	22.8333 LF	22	119	8	0	12.82	49.58	1.81	6.94
Bits         Desc         Desc <thdesc< th="">         Desc         Desc         <thd< td=""><td>Bidg 13-Unit C</td><td>7444 37</td><td>23.8333 LF</td><td>13</td><td>- 21</td><td>0</td><td>0</td><td>2.42</td><td>11.25</td><td>0.73</td><td>1.91</td></thd<></thdesc<>	Bidg 13-Unit C	7444 37	23.8333 LF	13	- 21	0	0	2.42	11.25	0.73	1.91
Disg         Disg <thdisg< th="">         Disg         Disg         <thd< td=""><td>Bog 14-Unit A</td><td>041 38</td><td>20.5633 LF</td><td>16</td><td>- 40</td><td></td><td>0</td><td>0.00</td><td>10.17</td><td>0.78</td><td>2.99</td></thd<></thdisg<>	Bog 14-Unit A	041 38	20.5633 LF	16	- 40		0	0.00	10.17	0.78	2.99
Dag         Function         The SF         22353 LF         C         S         D <thd< th="">         D         D         <thd< th=""></thd<></thd<>	Dide 14 Link C	742.00	20.0033 LF		-	ů č		0.17	20.42	1.1	0.02
Bag in Sum P         Trib SP         22.5 S IF         0         1         0         0         0.000         1.22 S         0.000         0.000         0.000         0.012 S         0.000         0.02 S         0.012 S         0.000         0.02 S         0.000         0.02 S         0.000         0.02 S         0.000         0.02 S         0.012 S         0.000         0.02 S         0.000         0.000         0.02 S	Bide 14 Line D	710 55	20.0000 LF			ě.		0.00	1.76	0.00	0.10
Basg 1-4-bit E         Th0 SF         22.15 D         0         1         0         0         0.00         0.042         1.75         0.005           Basg 1-4-bit E         700 SF         22.03033 UF         0         5         0         0         0.42         1.75         0.065           Basg 1-4-bit E         641 SF         20.0533 UF         0         5         0         0         3.33         2.066         0.52           Basg 15-bit E         620 SF         20.0533 UF         6         0         0         3.33         0.000         0.43           Basg 15-bit E         620 SF         20.0633 UF         4         0         0         0         1.67         0.000         0.33           Basg 15-bit E         620 SF         20.0633 UF         4         0         0         0         1.67         0.000         0.28           Basg 15-bit E         600 SF         775 SF         7.85 UF         4         0         0         1.67         0.000         0.28           Basg 15-bit E         600 SF         10.4167 UF         3         0         0         1.25         0.42         0.27           Basg 15-bit E         600 SF         10.4167 UF	Bidg 14-Unit D	710 35	22/9 15					0.00	0.45	0.00	0.18
Big         1-Lint         Dis OF         200 DSF         200 DFF         200	Dido 14-1 log E	743 55	23 (23) 33 1 5		1000	ň	ő	0.42	1.75	0.05	0.00
Big 14-Unit H         641 SF         20.5833 LF         6         3         0         0         2.50         1.25         0.39           Big 15-Unit A         778 SF         25.6657 LF         8         0         0         0         3.33         0.00         0.43           Big 15-Unit A         778 SF         25.6657 LF         8         0         0         0         3.33         0.00         0.43           Big 15-Unit C         625 SF         20.5833 LF         4         0         0         0         1.677         0.00         0.28           Big 15-Unit C         625 SF         20.5833 LF         4         0         0         0         1.677         0.00         0.28           Big 15-Unit C         625 SF         20.5833 LF         4         0         0         1.677         0.00         0.28           Big 15-Unit F         606 SF         19.4167 LF         3         0         0         0         1.25         0.42         0.21           Big 15-Unit A         645 SF         19.457 LF         5         0         0         0         1.25         0.00         0.28           Big 15-Unit A         645 SF         40.8333 LF         0 <td>Bide 14-Link C</td> <td>630 55</td> <td>20,5833 1.F</td> <td></td> <td>5</td> <td>0</td> <td>ő</td> <td>3.33</td> <td>2.08</td> <td>0.52</td> <td>0.35</td>	Bide 14-Link C	630 55	20,5833 1.F		5	0	ő	3.33	2.08	0.52	0.35
Bag 15 Link A         778 SF         23.5657 LF         8         0 <th0< th="">         0<!--</td--><td>Ride 14-Link H</td><td>641 55</td><td>20,5833 LE</td><td>6</td><td>3</td><td>0</td><td>0</td><td>2.50</td><td>1.25</td><td>0.39</td><td>0.20</td></th0<>	Ride 14-Link H	641 55	20,5833 LE	6	3	0	0	2.50	1.25	0.39	0.20
Bing         Ellipsi (E-Unit B)         Bing (E-Unit B) <td>Run 16 Link A</td> <td>729.52</td> <td>26 1667 LF</td> <td>8</td> <td>0</td> <td>0</td> <td>0</td> <td>133</td> <td>0.00</td> <td>043</td> <td>0.00</td>	Run 16 Link A	729.52	26 1667 LF	8	0	0	0	133	0.00	043	0.00
Bibg 15-Unit C         Bibg 15	Ride 15-Unit R	830 55	20 5833 15	1.4	õ	0	0	1.67	0.00	0.26	0.00
Big 15-Link D         TO: 57 SF         TAS SUF         4         1         0         0         187         0.42         0.221           Big 15-Link F         606 SF         10 4107 UF         3         1         0         0         125         0.422         0.221           Big 15-Link F         606 SF         10 4107 UF         3         0         0         0         125         0.422         0.211           Big 15-Link F         606 SF         10 4107 UF         3         0         0         0         125         0.422         0.211           Big 15-Link F         606 SF         10 4107 UF         3         0         0         0         0.216         0.000         0.218           Big 15-Link F         646 SF         40.8333 UF         0         11         0         0         0.000         4.56         0.001           Big 16-Link B         64.3 2F         40.8333 UF         0         11         0         0         0.000         9.58         0.000           Big 16-Link B         64.3 2F         24.5 UF         0         0         0         0.000         0.000         0.000         0.000         0.000         0.000         0.000         0.0	Bido 15-Unit C	855 SE	20.5833 LE	10.00	ā.	ö	ő	1.67	0.00	0.26	0.00
Bitsg 15-Link E         DDD OF         19.44107 LF         3         1         0         0         1.25         0.42         0.21           Bitsg 15-Link F         DDD OF         19.4107 LF         3         0         0         0         1.25         0.42         0.21           Bitsg 15-Link F         DDD OF         1.4107 LF         3         0         0         0         1.25         0.402         0.21           Bitsg 15-Link F         DDD OF         2.4.5 LF         5         0         0         0         0         0.208         0.000         0.21           Bitsg 15-Link F         DDL OF         2.4.5 LF         C         0         0         0         0         0.208         0.000         0.218           Bitsg 15-Link F         DDL OF         2.0.5033 LF         0         11         0         0         0.000         4.56         0.000           Bitsg 15-Link F         DDC OF         19.4167 LF         0         0         0         0         0         0.000         0.000         0.000           Bitsg 15-Link F         DDC OF         19.4167 LF         0         0         0         0         0         0.000         0.000         0.000 <td>Bidg 15-Unit D</td> <td>757 55</td> <td>745 LE</td> <td>1000</td> <td>100</td> <td>0</td> <td>0</td> <td>1.67</td> <td>0.42</td> <td>0.22</td> <td>0.05</td>	Bidg 15-Unit D	757 55	745 LE	1000	100	0	0	1.67	0.42	0.22	0.05
Bag is Lunk F         600 SF         19.4167 LF         3         0         0         0         125         0.00         0.21           Bidg is Lunk F         600 SF         19.4167 LF         3         0         0         0         126         0.00         0.21           Bidg is Lunk F         600 SF         20.5873 LF         2         0         0         0         0.266         0.00         0.21           Bidg is Lunk A         644 SF         40.833 LF         0         1         0         0         0.266         0.00         0.23           Bidg is Lunk A         644 SF         40.833 LF         0         11         0         0         0.00         8.466         0.00           Bidg is Lunk A         644 SF         40.833 LF         0         11         0         0         0.00         8.466         0.00           Bidg is Lunk A         745 SF         24.5 LF         0         0         0         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         <	Dido 15-Linit E	100 SF	10.4167 LF	3	1	0	0	1.25	0.42	0.21	0.07
Bibg 15-Link G         T37 SF         24.5 LiF         5         0         0         0         2.06         0.00         0.28           Bibg 15-Link H	Bide 15-Link F	606 SF	19.4167 LF	3	0	õ	õ	1.25	0.00	0.21	0.00
Big 15 Unit H         Big 15 U	Blog 15-Unit G	757 5#	24.5 LF	6	0	0	0	2.09	0.00	0.28	0.00
Bidg 15-Link /         Bid 15E         20.5933 LF         3         0         0         0         1.25         0.00         0.20           Bidg 15-Link /         Bids 5F         40.8333 LF         0         11         0         0         0.00         4.56         0.00         0.20           Bidg 15-Link /         Bids 15-Link /         645 SF         40.8333 LF         0         11         0         0         0.00         4.56         0.00           Bidg 15-Link //         643 SF         40.8333 LF         0         23         0         0         0.00         4.56         0.00           Bidg 15-Link //         745 SF         24.5 LF         0         0         0         0.00 <td>Biolog 15-Unit H</td> <td>634 SF</td> <td>20.5833 LF</td> <td>2</td> <td>0</td> <td>0</td> <td>0</td> <td>0.83</td> <td>0.00</td> <td>0.13</td> <td>0.00</td>	Biolog 15-Unit H	634 SF	20.5833 LF	2	0	0	0	0.83	0.00	0.13	0.00
Bidg 15 Unit A         645 SF         40.8333 UF         0         11         0         0         0.00         4.56         0.00           Bidg 15 Unit A         643 SF         40.8333 UF         0         11         0         0         0.00         4.56         0.00           Bidg 15 Unit A         643 SF         40.8333 UF         0         0         0         0.00         0.60         0.60         0.00	Bidg 15-Unit I	641.5#	20.5833 LF	3	0	0	0	1.25	0.00	0.20	0.00
Bidg (E-Unit B)         643 3F         40 833 LF         0         23         0         0         0.00         8.58         0.00           Bidg (E-Unit C)         762 3F         24.5 LF         0         0         0         0.00	Bidg 16-Unit A	645 SF	40.8333 LF	0	11	Ú.	0	0.00	4.68	0.00	0.71
Bibg 16-Unit C         742 SF         24.5 UF         0         0         0         0         0.00	Bidg 16-Unit B	643 SF	40.8333 LF	0	23	0	0	0.00	9.58	0.00	1.49
Blag (E-L) HE D         000 (SF         19.4 (17) LF         0         0         0         0         0.00	Bidg 16-Unit C	762 5≢	24.5 LF	0	0	0	0	0.00	0.00	0.00	0.00
Bidg 15-Link E         106:EF         19.4167 LF         0         1         0         0         0.00         0.42         0.00           Bidg 15-Link F         746:SF         24.5 LF         0         0         0         0.00         0.00         0.40         0.00	Bidg 16-Unit D	806 SF	19.4167 LF	0	0	0	0	0.00	0.00	0.00	0.00
Bidg 15-Unit A         764 SF         24.5 LF         0         0         0         0         0.00	Elidg 16-Linit E	806 SF	19.4167 LF	0	1	0	0	0.00	0.42	0.00	0.07
Bidg 17-Unit A         746 SF         23.9167 LF         0         2         0         0         0.00         0.83         0.00           Bidg 17-Unit A         746 SF         23.9167 LF         0         66         0         0.000         28.35         0.000           Bidg 16-Unit A         764 SF         23.45 LF         5         50         0         0         2.08         20.85         0.001           Bidg 16-Unit A         764 SF         24.5 LF         5         50         0         0         2.08         20.85         0.27           Bidg 16-Unit A         764 SF         24.5 LF         5         50         0         0         3.33         0.000         0.85           Bidg 16-Unit B         606 SF         18.4167 LF         0         10         0         0.000         4.17         0.00           Bidg 16-Unit D         782 SF         24.5 LF         3         0         0         0         1.25         0.000         0.16           Bidg 16-Unit D         782 SF         24.5 LF         3         0         0         0         0.00         1.00         107.25	Bloig 16-Unit F	764 SF	24.5 LF	0	0	0	0	0.00	0.00	0.00	0.00
Bldg 17-Unit B         747:5F         23.9167 UF         0         66         0         0         0.00         28.35         0.00           Bldg 18-Unit A         764:5F         24.5 UF         5         50         0         0         2.06         20.83         0.27           Bldg 18-Unit A         666:5F         19.4167 UF         6         0         0         0         3.33         0.00         0.65           Bldg 18-Unit C         666:5F         19.4167 UF         0         10         0         0.00         4.17         0.00           Bldg 18-Unit C         666:5F         19.4167 UF         0         10         0         0.00         4.17         0.00           Bldg 18-Unit D         782:5F         24.5 UF         3         0         0         0         1.25         0.00         0.16           Bldg 18-Unit D         782:5F         40.0530 UF         1543         0         50         0         608,25         0.00         1.07,25	Bidg 17-Unit A	746 SF	23.9167 LF	0	2	0	0	0.00	0.83	0.00	0.11
Bldg BLuhr A 764 GF 24.5 UF 5 50 0 0 208 2083 0.27 Bldg BLuhr B 606 SF 194.4167 UF 8 0 0 0 3.33 0.00 0555 Bldg I9-Unit C 606 SF 194.4167 UF 0 10 0 0 0.000 4.17 0.00 Bldg I9-Unit D 782 SF 24.5 UF 3 0 0 0 1255 0.00 0.18 Bldg I9-Unit D 782 SF 40.0573 UF 1143 0 50 0 0 963.25 0.00 107.23	Bidg 17-Unit B	747 SF	23.9167 LF	0	66	0	0	0.00	28.35	0.00	3.79
B43g 19-Unit B 906 SF 19.4167 LF 8 0 0 0 3.3.3 0.00 0.55 B43g 19-Unit C 606 SF 19.4167 LF 0 10 0 0 0.000 4.17 0.00 B43g 19-Unit D 752 SF 24.5 LF 3 0 0 0 1.25 0.00 0.16 B43g 19-Unit D 752 SF 40.0033 LF 154.3 0 50 0 962 75 0.00 107 23	Bidg 18-Unit A	764 SF	24.5 LF	5	50	0	0	2.09	20.85	0.27	2.73
Blag 19-Unit C 606 SF 19-14167 LF 0 10 0 0 0.000 4.17 0.000 Blag 19-Unit D 782 SF 24-5 LF 3 0 0 0 1.25 0.00 0.16 Blag 19-Unit E 943 SF 4016330 LF 11543 0 50 0 696,275 0.000 107,23	Bidg 18-Linit B	606 SF	19.4167 LF	8	0	0	0	3.33	0.00	0.56	0.00
Bidg 18-Unit D 762 SF 24.5 UF 3 0 0 0 125 0.00 0.16 Bidg 18-Unit E 643 SF 40.8333 UF 1543 0 50 0 690 75 0.00 103.23	Bidg 18-Unit C	606 SF	19.4167 LF	0	10	0	0	0.00	4.17	0.00	0.69
80g 19-014 E 643 5F 40.8333 UF 1543 0 50 0 603.75 0.00 103.23	Bidg 18-Unit D	762 SF	24.5 LF	3	0	0	0	1.25	0.00	0.16	0.00
	Blog 19-On# E	645 SF	40.8333 LF	1543	0	50	0	663.75	0.00	103.25	0.00
100g 16-Unit 1 1945 27 40 8333 UF 1548 0 50 0 885 83 0.00 103.23	mag til-Unit F	545 SF	40.8333 LF	1548	0	50	0	685 83	0.00	103.23	0.00
Storage suising SF LF 0.00 0.00	atorage Building	SF	LF					0.00	0.00		



## RCI, Inc. 800-828-1902 www.rci-online.org

Table 2 – Breakdown of damage by unit.

#### References

<sup>1</sup> "From Asbestos to Zinc, Roofing for Historic Buildings—Composition," http://www.cr.nps.gov/hps/tps/ roofingexhibit.htm, accessed on 21 October 2005. <sup>2</sup> Ibid.

### David A. Rash, RRC, Assoc. AIA

David A. Rash, RRC, Assoc. AIA, a roof consultant with the Seattle, Washington, office of Madsen, Kneppers & Associates, Inc., first became involved in roofing and architecture in 1973. He is a professional member of RCI, an associate member of the American Institute of Architects, a member of the Society of Architectural Historians, and has written extensively on construction and historic architecture. Mr. Rash serves on RCI's RRC Examination Development Committee and AIA Seattle's Historic Resources Committee.

