2003 Uniform Plumbing Code
2003 International Residential Code
Plumbing Cost Comparison
for Plumbing Installation

DATE: June, 2003

TO: Code Enforcement Officials, Members of Plumbing Code Adoption Boards, and Interested Members of the Plumbing Community

FROM: Edward Saltzberg,* PE, CEM, CIPE
J. Richard Wagner,* PE, CIPE
Robert Payne*

RE: **2003 Uniform Plumbing Code/2003 International Residential Code Plumbing Cost Comparison for Plumbing Installation**

This study has been conducted to resolve the questions raised about the cost differences in using the minimum required plumbing installation using the International Residential Code over the Uniform Plumbing Code. The authors of this report, in order to either substantiate or refute the claims of rough plumbing cost variances, decided to independently evaluate one plumbing installation for a typical single family residence. The typical residence was a recommended plan from Good Housekeeping Magazine. The following are the results of our investigation and our conclusions.

CONCLUSIONS

	WASTE & VENT PLUMBING SYSTEM COST					
			DIFFERENCE			
	UPC SYSTEM	IRC SYSTEM	UPC>IRC	IRC>UPC	APPROXIMATE COST OF TOTAL PLUMBING	APPROXIMATE % DIFFERENCE OF TOTAL PLUMBING SYSTEM COST
RESIDENCE	980.39	911.15	69.24	---	4901.95	1.4%

1 For breakdown of costs for the installations, see schedule in this report.

As indicated by the summary above, there is not much difference in total cost between the rough waste and vent plumbing installations under the two competing plumbing codes for this residential project. Furthermore, any differences that do occur could be easily reversed by local plumbing contractor bidding procedures and local pricing. Also, the writers feel that, whereas there are some small cost differences, there are significant quality differences in the subject plumbing installations between the two competing systems. The writers feel that the IRC allowance of the use of air admittance valves, as opposed to installing vents through the roof, and the limited number of cleanouts with the IRC system is not in the consumers' best interest and does not create appreciable savings for the developer, the contractor, or the homeowner. In addition, the authors feel that,

*A brief bio on each writer is included at the end of this report. A complete Curriculum Vitae on each writer is included at the end of this

what little cost differences occur will be more than offset by the anticipated future maintenance and service costs created by use of the IRC.

The authors hope this independent cost comparison of a typical residential installation puts to rest any discussion regarding the supposed significant cost savings achieved through the use of one plumbing code over the other. In addition, even though there is little cost difference between the two code systems, the authors wish to emphasize that initial cost should never be the total criteria for a plumbing system design. We believe the workability, the long-term life cycle costing of a plumbing system, as well as the health and safety of the public, should be the major deciding factors. Based on all of these criteria, we feel that the installation provided under the Uniform Plumbing Code provides a better minimum system for the ultimate user and is superior to that provided under the International Residential Code and still does not cost the consumer much more.

REPORT

The authors took one typical residential construction which is representative of the area's variety of residential construction nationally. The typical house plan was a recommended plan from Good Housekeeping magazine. This residential construction project comprises the bulk of the residential single family market and the authors were interested in seeing and comparing the actual cost of the rough waste and vent plumbing systems designed per the minimums of the 2003 Uniform Plumbing Code and the 2003 International Residential Code. This project did not include any unique or abnormal construction features not normally encountered in common construction.

The reason that only the rough waste and vent system was costed is because the water system and the gas system might have identical cost under both codes and the finish waste and vent would be the same. Both codes allow for the use of PEX manifold water system and CSST manifold gas system. Although the water distribution piping would be similar between the IRC and UPC, the pipe sizing procedure in IPC Appendix L results in an unrealistically high peak demand of 18.9 GPM, including demand of the two hose bibs. The calculated UPC demand is 14 GPM, based on the allowance for bathroom

groups in Appendix L, and is more realistic for a dwelling unit with two baths. The difference could affect the size of the water service. Therefore, there might or might not be any difference in the costs of the water and gas systems between the two plumbing codes.

Furthermore, the authors excluded the cost of the plumbing fixtures or shower mixing valves, fixture connections, the water service to the building, the sewer lateral, the trenching, plumbing permits, etc., as all these items would be the same under both code rough plumbing installations. Therefore, the authors used only the actual cost of rough waste and vent systems which, theoretically, would incorporate any difference in plumbing costs created by the two different plumbing codes. In addition, sales tax was excluded, as this item varies considerably from state to state across the nation. Also, as part of the rough plumbing cost, no amount was added for overhead and profit, as this also varies considerably from contractor to contractor.

To obtain the approximate percentage difference of the total plumbing systems shown on Page 1, the rough plumbing cost difference between the two code systems was divided by the approximate total plumbing system cost to determine the approximate percentage difference.

The authors designed minimum waste and vent systems as allowed and required by the 2003 Uniform Plumbing Code and the 2003 International Residential Code. Edward Saltzberg designed the UPC plumbing systems due to his knowledge of the UPC, and J. Richard Wagner designed the IPC plumbing systems due to his knowledge of the BOCA/IPC codes. Robert Payne, former plumbing contractor, prepared an actual plumbing takeoff of materials and labor in consultation with other plumbing contractors in order to obtain actual current labor factors. The results of this study are shown in the conclusion at the beginning of this report, and the breakdowns of the various rough plumbing systems and drawings for the various individual projects and piping systems are included later in this report.

The authors wish to acknowledge that the following items were incorporated into the rough plumbing system pricing.

1. ABS fittings - Changed 1-1/4" pipe and fittings to 1-1/2" pipe and fittings because 1-1/4" fittings are double the cost of 1-1/2" fittings and there is only a small selection of 1-1/4" fittings. Therefore, it is cheaper to use 1-1/2" ABS pipe and fittings.

2. Used sanitary tees in place of vent tees because they cost less.

3. Used 1/4 bends in place of vent ells because they cost less.

4. Increased size of IPC waste lines in some places to install cleanouts as required by the IRC or as required by fitting sizing.

The representative residential building used in the plumbing cost comparison consists of:

1. A single-story residence consisting of approximately 1,800 square feet living area, excluding the garage, with three bedrooms, two bathrooms. The residence contains two water closets, three lavatories, one bathtub/shower, one bathtub, one shower, one kitchen sink with garbage disposer, one dishwasher, one refrigerator with icemaker, two hose bibs, one forced air unit, one washing machine, one clothes dryer, one water heater, one fireplace, and one barbecue connection. The approximate cost of the total plumbing system is approximately $4,901.95.

The following is a summary of the rough plumbing for the three typical residential plumbing projects used in this study.

	RESIDENCE ROUGH WASTE & VENT PLUMBING COST			
	UPC System		IPC System	
	Labor	Materials	Labor	Materials
Rough Waste & Vent	20.67 hours	153.59	17.63 hours	205.95
Total Cost*	980.39		911.15	
Difference	3.04 hours +	--	--	$52.36 +
Cost Difference*	$69.24			

* Cost difference is based on plumber's labor cost of $40.00 per hour.

Note: The waste and vent system represent approximately 20% of the total plumbing cost of the structure. Therefore, the entire plumbing system costs approximately $4900, so the difference in cost between the two systems is about 1.4% which can be more than offset by the bidding procedure of the contractors.

Edward Saltzberg*, PE, CEM, CIPE
Date: 5/15/98

State Licenses:

Active		Not Active	
Arizona	New Jersey	Connecticut	Maryland
California	New Mexico	Florida	
Colorado	Ohio	Iowa	
Georgia	Oklahoma	Kansas	
Illinois	Pennsylvania	Michigan	
Indiana		Tennessee	
Massachusetts		Texas	
Nevada		Washington	

(Engineer's Stamp)

J. Richard Wagner*, PE, CIPE
Date: 5/15/98

State Licenses:

(Engineer's Stamp)

Robert C Payne
Date: 5/15/98

Contractors Licenses:

C-36 Plumbing Contractor (Primary)
C-16 Fire Protection Contractor
C-20 Warm Air Heating, Ventilating & Air Conditioning
C-34 Pipeline Contractor
C-42 Sanitation Systems Contractor
B-1 General Building Contractor
HAZ Hazard Substance

J. Richard Wagner, PE. CIPE, is the chief engineer for the Poole & Kent Corporation, a large mechanical contractor in Baltimore, Maryland. He has almost fifty years experience in the design and construction of mechanical systems and is active on various plumbing code committees including Baltimore County, the National Standard Plumbing Code (NSPC), and the Uniform Plumbing Code (UPC).

Edward Saltzberg, PE. CEM, CIPE, is a consulting engineer with over fifty years of experience in the design and forensic review of plumbing, piping, HVAC, indoor air quality, and fire protection systems for all types of structures and systems. He has physically worked at most facets of construction, taught plumbing and mechanical system design, has been very active in code writing and interpretation, and has written and spoken extensively on plumbing matters.

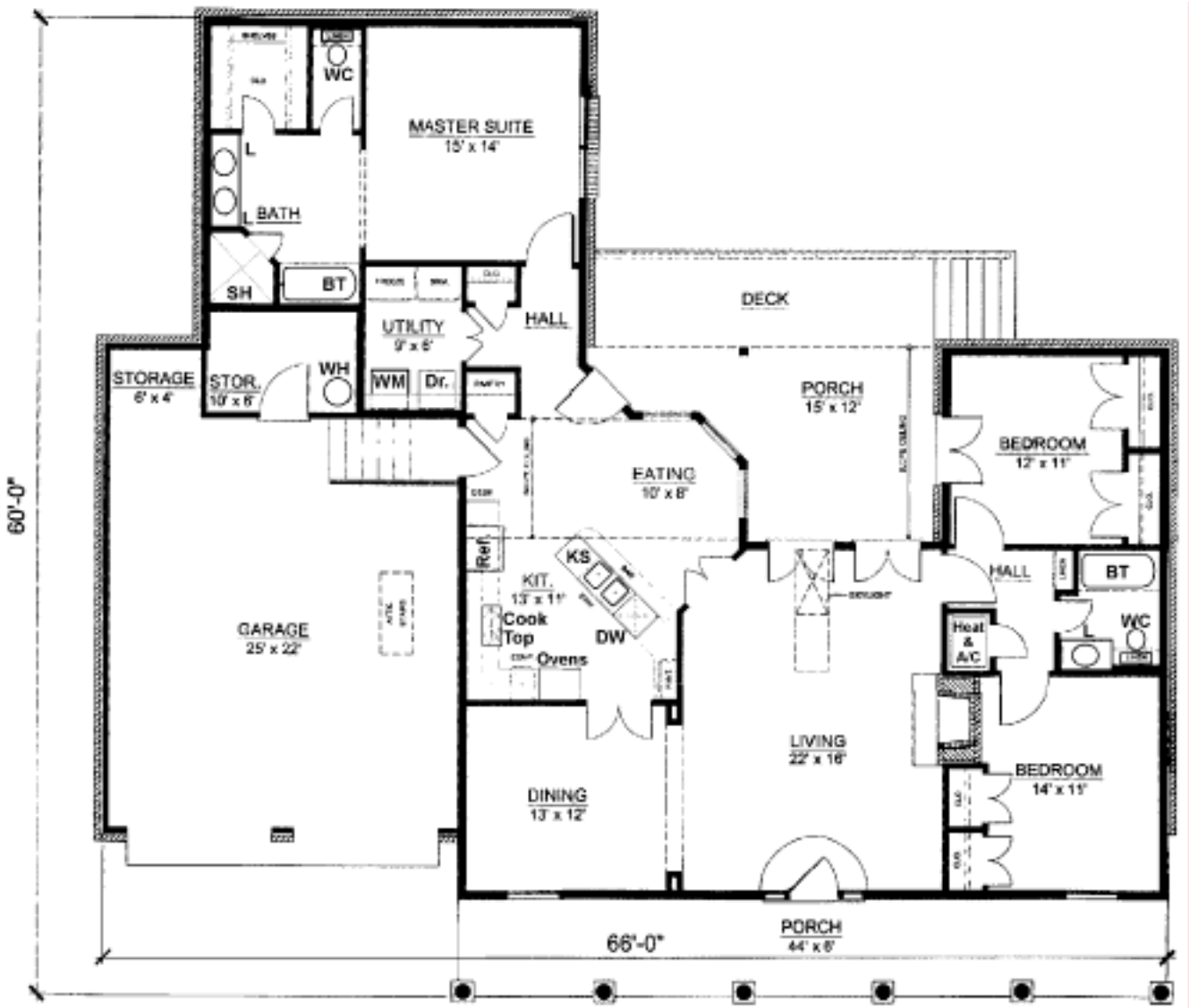
One of the co-founders, and past president, of the American Society of Plumbing Engineers, Mr. Saltzberg has served the Society in many capacities over the years. He is currently licensed as a professional engineer in thirteen states, a registered fire protection engineer, a certified energy manager, a journeyman plumber, and a fellow in the National Academy of Forensic Engineers. He has owned his own consulting engineering firm in southern California for thirty five years and serves as its president. He has been retained by plaintiffs or defendants in over three hundred litigation cases concerning plumbing and/or mechanical systems.

Robert C. Payne, Master Plumber, has been employed in activities in the plumbing engineering community for approximately forty years. Mr. Payne has been a design and install plumbing contractor for various companies and had his own plumbing company for sixteen years. Mr. Payne has been involved in various plumbing organizations and currently is with Keyline Sales as technical representative for plumbing products. Mr. Payne has been involved in numerous plumbing associations and has had leadership roles in the trades associations and is very knowledgeable on cost estimating.

The following pages include the architectural floor plan, the basic plumbing criteria, the plumbing installation drawings, and the material take-off sheets for all systems for both the 2003 Uniform Plumbing Code and the 2003 International Residential Code for the typical residential project.

RESIDENCE

ARCHITECTURAL PLANS AND ELEVATIONS



RESIDENCE FLOOR PLAN

2003 UPC/IRC COST COMPARISON

A1

GRAPHIC SCALE

0 1' 5' 10'

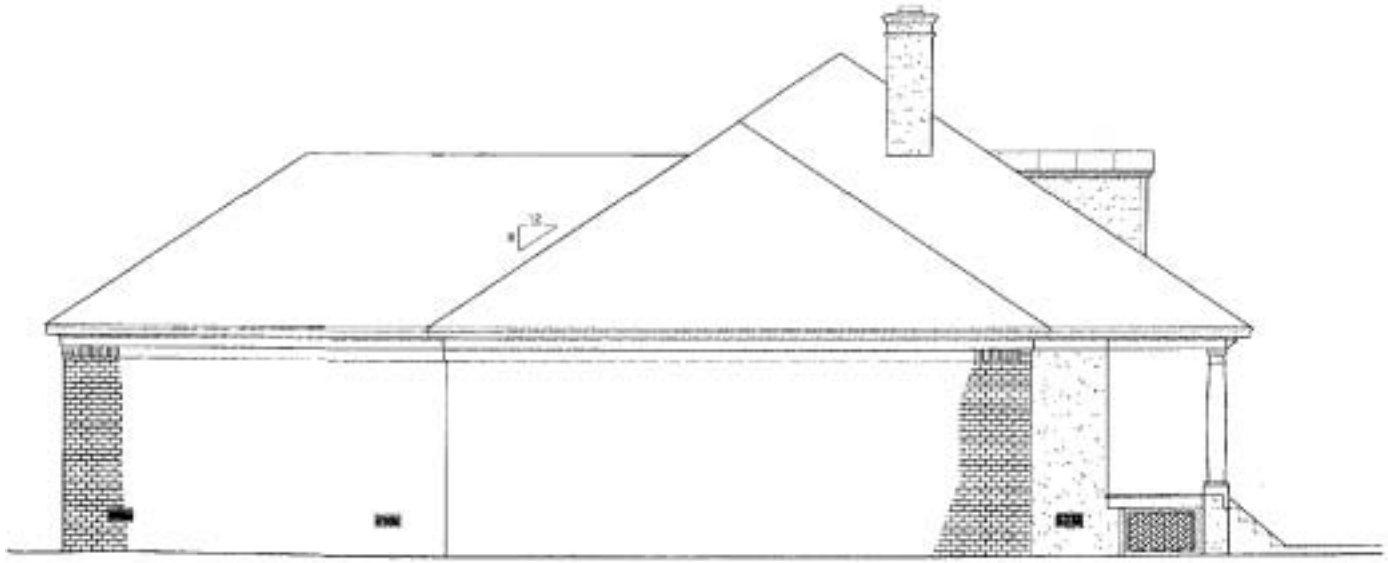
RESIDENCE
FRONT ELEVATION

2003 UPC/IRC COST COMPARISON **A2**

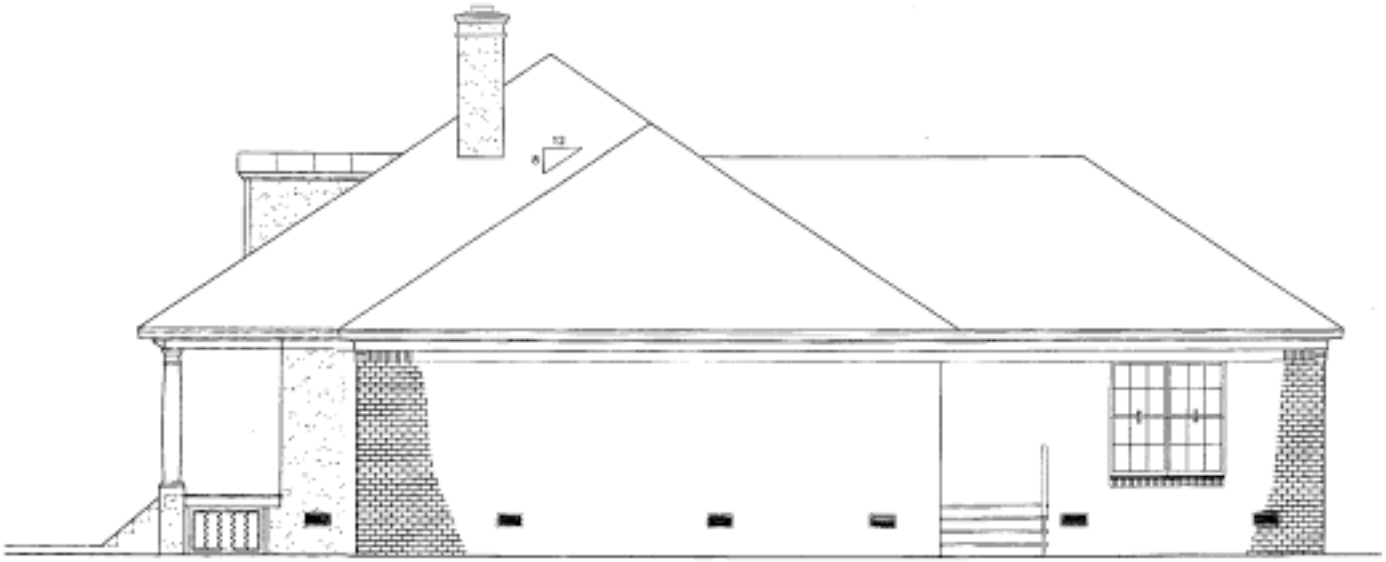
GRAPHIC SCALE

0 1' 5' 10'

RESIDENCE
REAR ELEVATION



RESIDENCE
LEFT ELEVATION



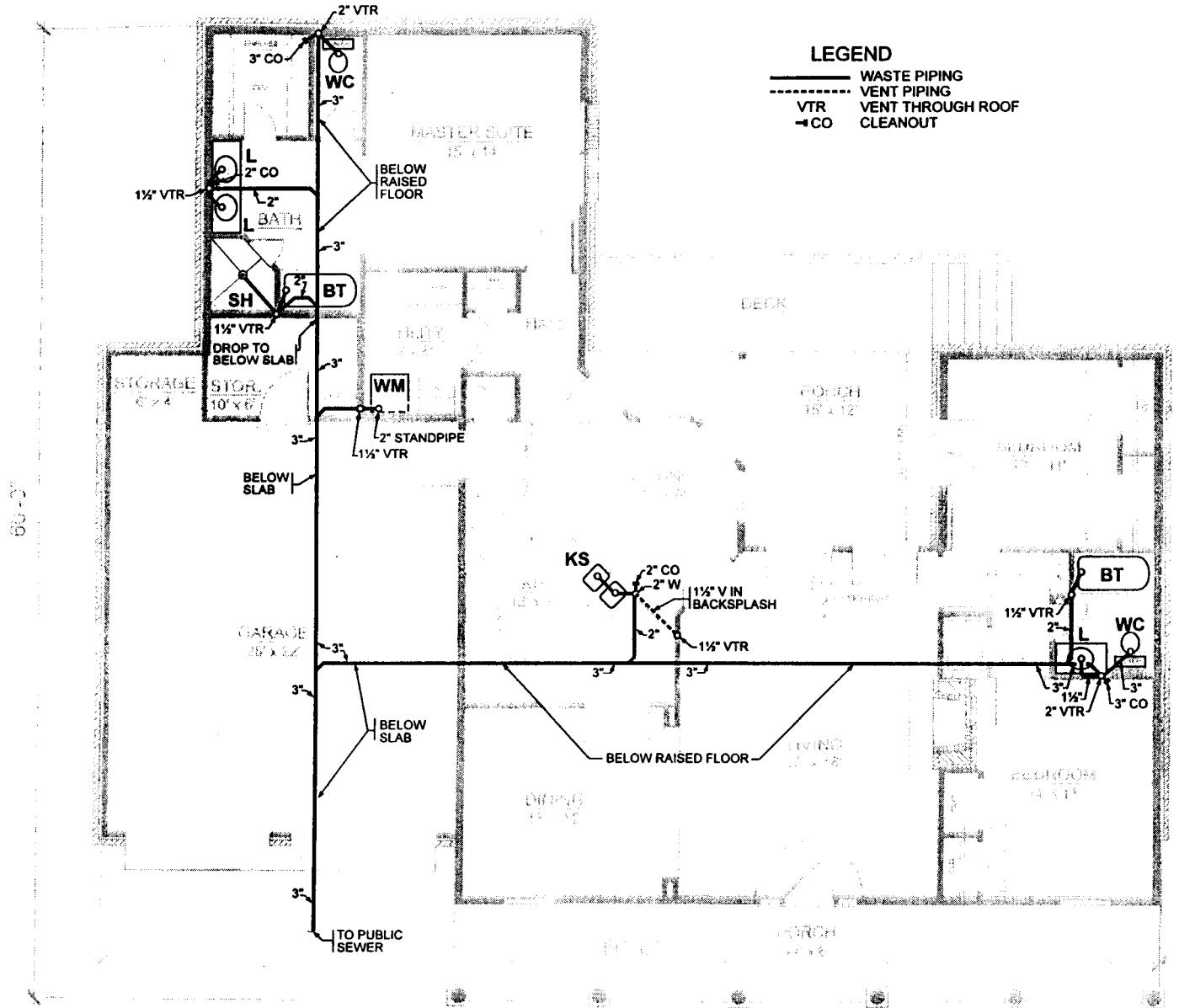
GRAPHIC SCALE
0 1' 5' 10'

RESIDENCE
RIGHT ELEVATION

RESIDENCE
INTERIOR ELEVATIONS

RESIDENCE

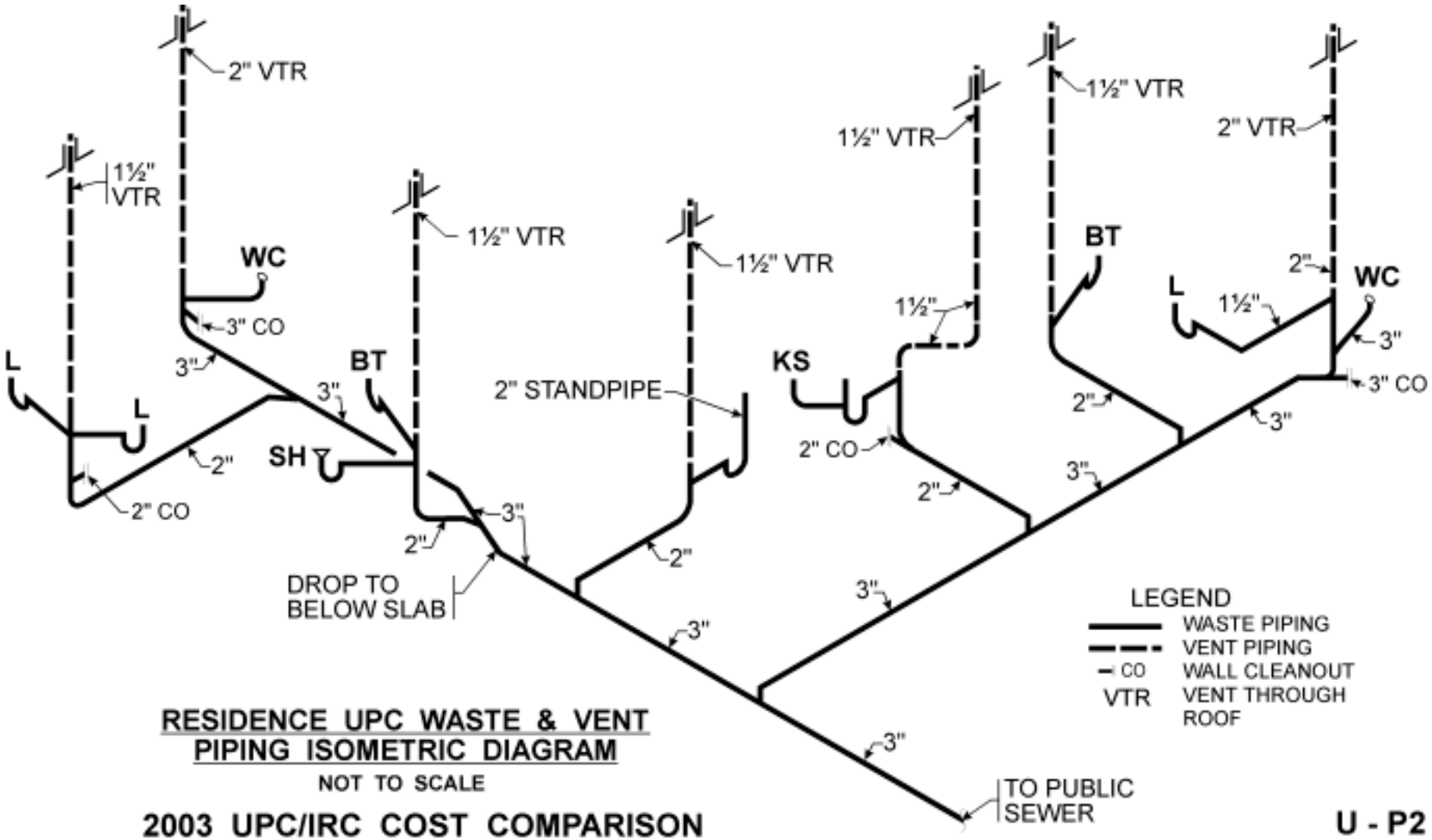
UPC WASTE & VENT PLUMBING PLAN AND DIAGRAM AND MATERIAL TAKE-OFF SHEETS



RESIDENCE UPC WASTE & VENT PIPING FLOOR PLAN

2003 UPC/IRC COST COMPARISON

U - P1



RESIDENCE UPC WASTE & VENT PIPING ISOMETRIC DIAGRAM

NOT TO SCALE

2003 UPC/IRC COST COMPARISON

U - P2

LABOR MATERIAL ESTIMATE SHEET

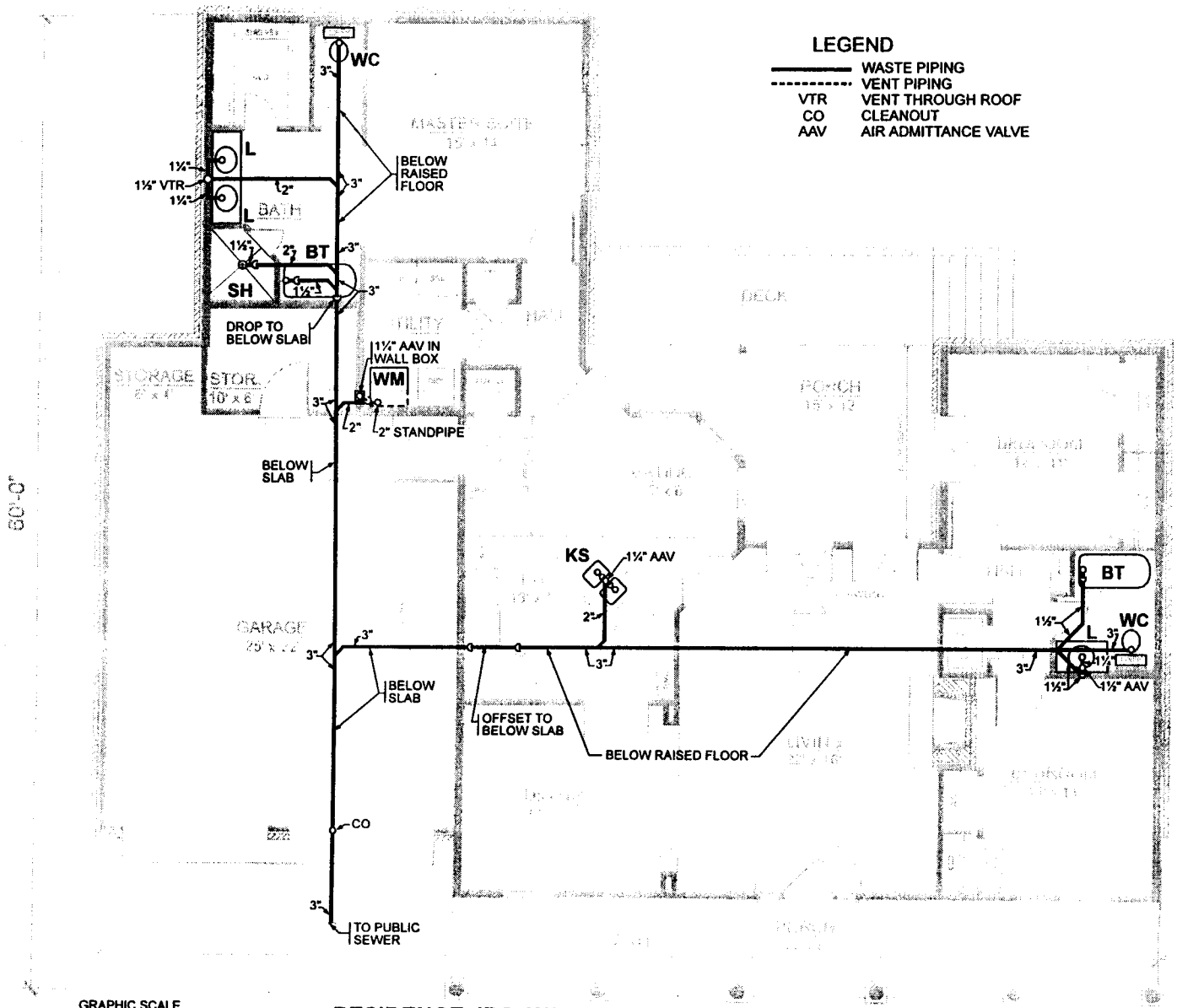
Job Name: Cost Comparison
Date: 6/4/03

System: W & V
Spec. Section: U.P.C.

Labor Estimate	Labor Unit	Quantity	Size	Description	Material Unit	Extension
8.48	0.08	106'	3"	ABS Pipe schedule 40 Net	$0.53	$56.18
3.06	0.06	51	2"	ABS pipe schedule 40 Net	$0.26	$13.26
3.25	0.05	65'	1 1/2"	ABS Pipe schedule 40	$0.20	$13.00
						$82.44
2.10	1.05	2	3"	Combination wye & 1/8 Bend	$15.13	$30.26
5.25	1.05	5	3 x 5	Combination wye & 1/8 Bend	$10.75	$53.75
2.10	0.70	3	3"	1/8 Bend	$6.02	$18.06
0.35	0.35	1	3"	SPG x cleanout with plug	$5.95	$5.95
1.05	1.05	1	3	Test tee hub x hub x cleanout with plug	$15.09	$15.09
1.58	0.79	2	4 x 3	90° closet ell hub x hub	$10.01	$20.02
2.10	1.05	2	3 x 3 x 2	90° ell with low heel inlet SPG x hub	$17.14	$34.28
0.88	0.44	2	4'	Closet flange hub	$5.69	$11.38
0.66	0.66	1	2'	Combination wylie x 1/8B hub x hub x hub	$7.22	$7.22
0.22	0.22	1	2"	Cleanout adapter SPG x cleanout with plug	$3.88	$3.88
1.76	0.44	4	2'	Long turn 90° long turn ell hub x hub	$3.71	$14.84
0.20	0.10	2	4"	Caps for water closet pipe	$0.20	$0.40
1.32	0.66	2	2"x 1 1/2" x 1 1/2"	Sanitary street tee SPG x hub x hub	$6.25	$12.50
0.66	0.66	1	2" x 1 1/2" x 1 1/2'	Sanitary tee hub x hub x hub	$3.33	$3.33
1.32	0.66	2	2" x 1 1/2" x 2'	Sanitary tee hub x hub x hub	$4.13	$8.26
0.66	0.66	1	2"	Sanitary tee hub x hub x hub	$4.28	$4.28
0.88	0.44	2	2"	P-trap hub x hub	$7.63	$15.26
0.80	0.40	2	1 1/2"	P-trap hub x hub	$5.71	$11.42
0.40	0.20	2	1 1/2"	Male trap adapter SPG x S.J.	$1.70	$3.40
1.60	0.40	4	1 1/2"	90° long turn ell hub x hub	$2.91	$11.64
0.66	0.66	1	2 x 1 1/2 x 1 1/2	Double ell hub x hub x hub	$6.79	$6.79
41.34	Less 50%					$292.01
20.67	Hrs.			x .15	=	$43.80
						$248.21
		5	1 1/2"	Flashings	$1.75	$8.75
		2	2"	Flashings	$1.80	$3.60
						$12.35
				Pipe		$82.44
				Fittings		$43.79
				Flashings		$12.35
				Misc. - strap, glue, etc.	$15.00	$15.00
				Total Material		**$153.58**

RESIDENCE

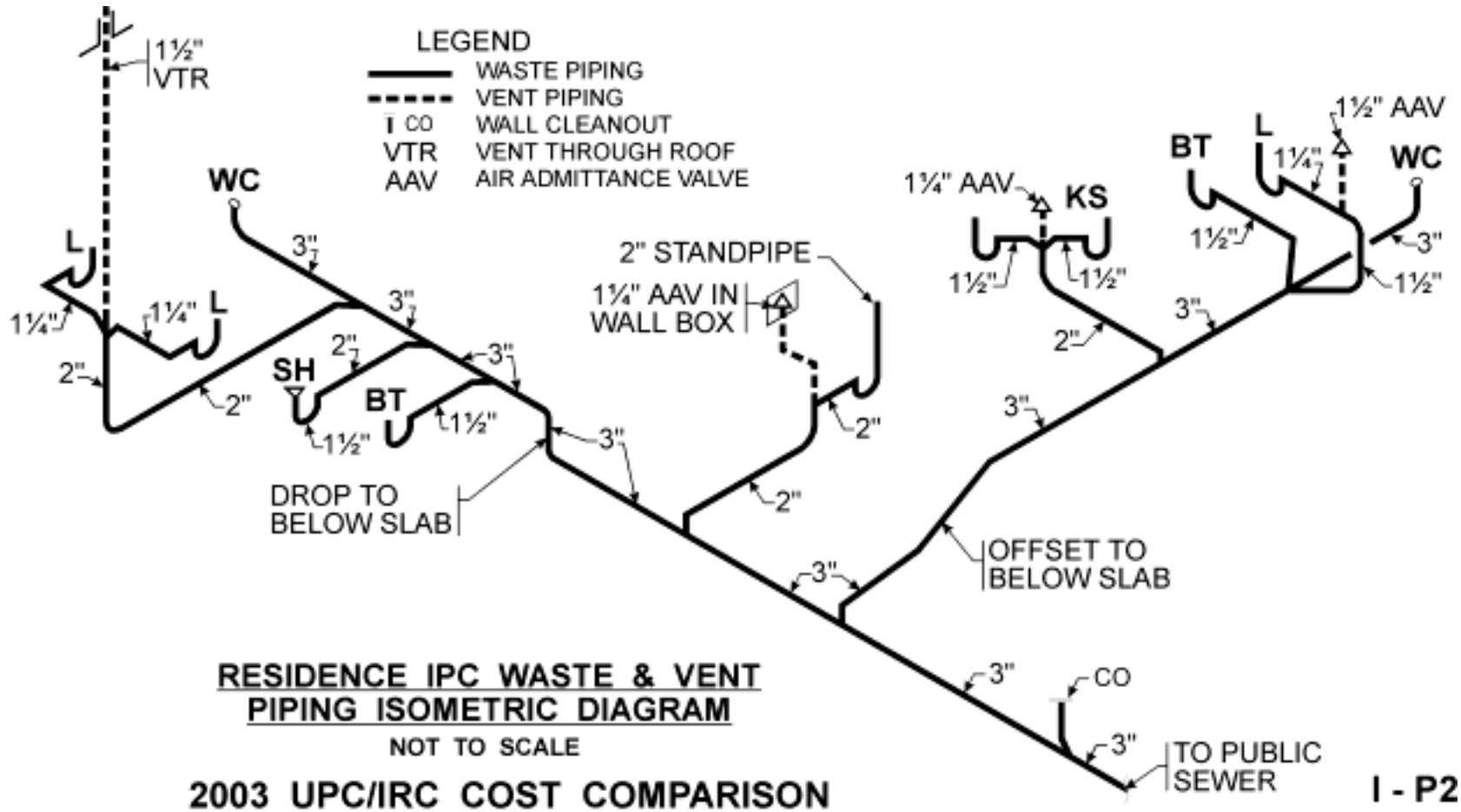
IRC WASTE & VENT PLUMBING PLAN AND DIAGRAM AND MATERIAL TAKE-OFF SHEETS



RESIDENCE IPC WASTE & VENT PIPING FLOOR PLAN

2003 UPC/IRC COST COMPARISON

I - P1



RESIDENCE IPC WASTE & VENT PIPING ISOMETRIC DIAGRAM

NOT TO SCALE

2003 UPC/IRC COST COMPARISON

LABOR MATERIAL ESTIMATE SHEET

Job Name: Cost Comparison
Date: 6/4/2003

System: W & V
Spec. Section: I.P.C. Code

Labor Estimate	Labor Unit	Quantity	Size	Description		Material Unit	Extension
8.64	0.08	108	3"	ABS Pipe schedule 40	Net	$0.53	$57.24
1.56	0.06	26'	2"	ABS pipe schedule 40	Net	$0.26	$6.76
1.55	0.05	31'	1 1/2"	ABS Pipe schedule 40	Net	$0.20	$6.20
							$70.20
				Fittings Are NIBCO			
2.10	1.05	2	3"	Combination wye & 1/8 Bend		$15.13	$30.26
3.15	1.05	3	3 x 2	Combination wye & 1/8 Bend		$10.75	$32.25
2.10	1.05	2	3" x 1 1/2"	Combination wye & 1/8 Bend		$14.85	$29.70
1.40	1.40	1	3" x 3" x 1 1/2" x 1 1/2"	Double wye hub x hub x hub x hub		$18.51	$18.51
1.20	0.40	3	1 1/2"	P-trap hub x hub		$5.81	$17.43
0.44	0.44	1	2"	P-trap hub x hub		$7.63	$7.63
0.44	0.22	2	1 1/2"	Female trap adapter hub x 55		$1.78	$3.56
0.88	0.44	2	4 x 3	90¡ closet ell hub x hub		$10.01	$20.02
0.20	0.10	2	4"	Caps for water closet pipe		$0.20	$0.40
2.80	0.70	4	3"	45¡ ell hub x hub		$6.02	$24.08
2.40	0.40	6	1 1/2"	Long turn 90¡ long turn ell hub x hub		$2.91	$17.46
1.64	0.82	2	1/2"	Double fixture tee hub x hub x hub x hub		$10.80	$21.60
0.60	0.60	1	1 1/2" x 1 1/4 x 1 1/2	Sanitary tee hub x hub x hub		$4.49	$4.49
0.66	0.66	1	2" x 1 1/2 x 1 1/2	Sanitary tee hub x hub x hub		$6.25	$6.25
0.22	0.22	1	1/2"	Flush bushing SPG x hub		$1.30	$1.30
0.44	0.44	1	2"	Coupling hub x hub		$1.33	$1.33
0.44	0.22	2	4"	Closet flange hub		$5.69	$11.38
							$247.65
					x .15%	=	$37.15
						Fittings	
0.60	0.20	3	1 1/2"	Stud or mini - vent	Net	$20.00	$60.00
0.60	0.20	3	1 1/2"	Stud or adaptor ABS - hub x FM.P ADP		$1.95	$5.85
0.50	0.50	1		Stud or multi-purpose recess			
				Box with grill	Net	$10.00	$10.00
							$75.85
0.70	0.70	1	3"	Tomcap with brass plug (3" w)	Net	$6.00	
	---	1	1 1/2"	FHA flashing		$1.75	
	---			Misc. - glue strap, etc.		$15.00	
35.26	Less 50%					**$22.75**	
17.63	Hrs						
				Pipe Cost			$70.20
				Fittings			$37.14
				Stud or vents, etc.			$75.85
				Misc.			$22.25
					Total Material		$205.44