



CERAMIC TILE INSTITUTE OF AMERICA, INC.
12061 Jefferson Blvd., Culver City, CA 90230-6219

CTIOA REPORT 76-1-2

SUBJECT: SHOWER AREAS -- BONDING TO WATER RESISTANT GYPSUM BACKING BOARD

Introduction

1. For many years the Tile Industry Technical and job Problem Committee and the Ceramic Tile Institute took a strong stand against adhering ceramic tile to gypsum wallboard in the shower areas. Some members of the Committee still feel strongly that it should not be done.
2. After several months of meeting and discussion on this subject the Technical and job Problem Committee changed its position on this method and has completed a specification for bonding tile directly to gypsum board for use in shower areas. This specification was submitted to the City of Los Angeles and the City has issued a Research Report allowing the method, if it is done according to prescribed procedures. A copy of the City of Los Angeles Research Report No. 24012 is attached to this Field Report. It contains information on the proper application of the gypsum board. It also contains information for the tile application in details 7, 8, 9, 10 and 11, It will be helpful to review them.
3. This decision was made because the majority of the Committee members believed the time had arrived for the use of this method.
 - A. Improvements have been made' in the water resistant gypsum backing board.
 - B. The method is used throughout the nation and California except in a few areas, Los Angeles being one of them.
 - C. Heavy pressure' was exerted by the Gypsum Association to,allow the system.
 - D. Heavy pressure was exerted, by; large the contractors to allow the system.
 - E. Some Committee members feel the system is every bit as good or- better than some of the competitive products being sold for use in these shower areas.
4. Other Committee members and also some of those who advocate use of the system are concerned about several items.
 - A. It is well documented that even though the product is called water resistant gypsum backing board it will wick in and absorb the water.
 - B. It is known that under certain conditions water does get into the gypsum board. It is strongly suspected by some that the water - enters the gypsum board by condensation. If this is true all of the sealing and protection of the board possible will. not prevent the condensation water from entering the gypsum board. If the condition is present to cause hot and cold to come together condensation will form.

- C. It will be necessary to obtain correct and exacting installation of the gypsum board' and some question if this can be consistently achieved.
- D. It will be necessary to install the tile in accordance with the developed specification and some question if this can be consistently achieved.
- E. The original City of Los Angeles Research Report carried a "T" after the approval number. It read 24012-T. This meant the system is on trial for one year. It was reissued as 24012.

Discussion

1. The balance of this Field Report will be in regard to work that has been done to develop the best way of installing the tile and bonding it to the gypsum board and making the installation water tight. The discussion will not be on the pros and cons, and other background information listed in the Introduction, about the use of the gypsum board.
2. Attached to this Field Report is the specification developed by the Tile Industry Technical and job Problem Committee.
 - A. The title and text will indicate that when it was developed the only material considered for bonding the tile was Type I organic adhesive which is a solvent type.
 - B. Checking with tile contractors in the field revealed that the tile was not being bonded with organic adhesive. Where the system was allowed the tile was being bonded with Dry-Set Portland cement mortar and latex type Portland cement mortar by many of the tile contractors.
3. Also attached to this Field Report is a series of test reports.
 - A. If products other than organic adhesive were to be used how did their performance compare with organic adhesive? For bond strength? For water penetration?
 - B. With these questions in mind the Technical and job Problem Committee requested tests be conducted, which are attached.
 1. Laboratory No. L-75--1911-A gives the bond strength of Type II organic adhesive, averaging 59 PSI and Type I organic adhesive 90 PSI.
 2. Laboratory: No-: L-75-1911-B gives the bond strength of latex Portland cement mortar, 149 PSI, and thin set (Dry-Set) portland cement mortar, 97 PSI. As can be seen Type I provides better bond values than Type II adhesive. Thin set (Dry-Set) portland cement mortar provides better bond strengths than Type I adhesive. Latex portland cement mortar provides the highest bond strengths.
 3. Laboratory No. L-76-3020 gives the results of water penetration tests on all of the bonding materials. The loss was so small that it had to be calculated in grams, and some of the loss was in absorption into the plastic pipe used for the tests, and by evaporation. This was true of all the products showing no advantage of one over the other.

It is to be noted that the water penetration tests were all conducted over tile bonded with the various materials to the green gypsum board and grouted.

4. A request to allow the latex type portland cement mortar and the thin set portland cement mortar, to be used to bond the tile to the water resistant gypsum board, has been submitted to the City of Los Angeles. This would be in addition to the Type I organic adhesive. It is contemplated the City of Los Angeles will approve the use of the additional bonding mortars.

Conclusion

1. The Tile Industry is faced with 'a real challenge in properly installing the ceramic tile in this method.
2. The gypsum applicators have requirements to follow in doing their work but it is up to the tile subcontractor to know when the board is properly installed, and treated, prior to bonding the tile to it. Therefore, details 1, 2, 3, 4, 5 and 6 of the City of Los Angeles Research Report No. 24012 should also be well understood.

CITY OF LOS ANGELES

Ceramic Tile Institute
700 North Virgil Avenue
Los Angeles, CA 90029
(213) 660-1911

RESEARCH REPORT: RR 24012

Date: February 11, 1986

GENERAL APPROVAL - Renewal-Installation of ceramic tile over weather-resistant gypsum backing board for showers and tub enclosures.

The above system is approved until January 1, 1987

Details:

1. Gypsum backing board shall comply with ASTM C630 and also be identified as Type X where fire resistance is required. Where two layers of board are required, such as two-hour walls, the first applied layer may be ordinary Type X board. The board shall be applied horizontally without vertical joints except at the corners. The factory paperbound edge of the gypsum board shall be spaced 1/4" above the lip of the receptor, tub or sub-pan.
2. Attachment. Boards shall be fastened with nails or screws spaced not more than 8" o.c. Where tile is more than 3/8" thick, the maximum spacing of nails or screws shall be 4" o.c. For double layer installations, adhesive is not permitted between sheets.
3. Blocking. Blocking between studs is required when ceramic tile is more than 3/8" thick and when studs are more than 16" o.c. One row of blocking is required approximately 1" above tub or receptor and another row at midpoint between tub or receptor and the ceiling. Blocking is also required behind soap dishes and towel racks.
4. Sealing. All cut edges of gypsum board, including any penetration holes shall be sealed with the tile adhesive or by USG Sheetrock W/R Sealant or Kaiser Moisture Guard Edge Sealant prior to attachment of the board to the wall.
5. Taping. All joints between boards shall be taped and covered with joint compound and finished to provide a smooth surface.
6. Penetrations. The only penetrations permitted in the gypsum board are holes for the passage of pipes. Where used, soap dishes shall be surface mounted. The maximum distance between pipe and hole is 3/8". This space shall be caulked with a material complying with "8" below.
7. Adhesive. Organic adhesive shall conform to ANSI A136.1-1967 Type 1 and must be specifically approved for the attachment of ceramic tile to gypsum board.
8. Caulking. The joint between tile and tub or receptor shall be caulked with rubber silicone, polyurethane or acrylic caulking compound complying with Federal Specification TT-S-00230(c) or TT-S-001543.
9. Application of tile adhesive. The backing board shall be completely covered with 1/16" of tile adhesive. After the skin coat is hardened so that it will not be grooved by a notched trowel the bedding adhesive shall be applied in accordance with manufacturers recommendations.
10. Inspection. Building inspection shall be notified two days before any ceramic tile is adhered in place. The tiling may be commenced after the two days without specific approval of the inspector.
11. This method of construction is not permitted in steam rooms, saunas, or their similar high moisture areas.

Discussion

The report is based on tests. In two layer application, the first layer of gypsum board extends to the floor.
Ceramic Tile Institute

RE: Installation of Ceramic Tile Over Weather Resistant Gypsum Backing Board for shower and Tub Enclosures.

For this General Approval to be valid on any individual construction project in the City of Los Angeles, an engineer or inspector of the Department of Building and Safety must make a determination that all conditions of the General Approval required to provide equivalency have been met in the case of each construction project under consideration.

W: ERGEMAN, Chief

Research and Development Division

INSTALLATION OF CERAMIC TILE WITH ORGANIC ADHESIVE BOND COAT OVER WATER-RESISTANT GYPSUM BACKING BOARD IN WET AREAS.

RECOMMENDED USES:

Interior over water-resistant gypsum board complying with ASTM-C630-74, in tub enclosures and shower stalls.

NOTE: Neither water-resistant gypsum board nor regular gypsum board shall be used in extremely critical exposure areas such as saunas, steam-rooms, or gang-shower rooms.

PREPARATION BY OTHER TRADES:

Water-resistant gypsum backing board complying with ASTM-C630-74 shall be applied horizontally spanning the full width of the tub or shower without vertical joints. *The* factory (paperbound) edge of the gypsum board shall be spaced a minimum of 1/4-inch above the lip of the receptor, tub or sub-pan (see sketches, Page 12). The gypsum board shall be attached with nails or screws spaced not over 8-inches o.c. except *that* when ceramic tile is more than 3/8-inch thick the fastener spacing shall be not over 4-inches o.c.

Where multiple layers of gypsum board are used for fire or sound rated construction, adhesive shall not be used between plys. The base ply shall extend the full height, floor to ceiling (see sketches, Page 12). backed gypsum board shall not be used. Building paper over the framing is not recommended but if used it shall be a single sheet of a non vapor barrier material (Grade D). Note - asphalt impregnated 15 pound felt is not considered a vapor barrier.

When framing is spaced more than 16-inches o . c . , suitable blocking or backing shall be located approximately 1-inch above the top of the tub or receptor and at the mid-point between the tub and ceiling. When ceramic tile is more than 3/8-inch thick, solid blocking is required between studs. One row of the blocking is located approximately 1-inch above the tub or receptor and an additional row at the mid-point between the tub and the ceiling. The spacing of studs 2-1/2-inches deep or less shall not exceed 16 inches o.c. Studs 3-1/2-inches or more in depth may be spaced 24 inches o . c . , provided blocking described above is utilized. Appropriate blocking, headers or supports shall be provided to support tub, other plumbing fixtures and to receive soap dishes, grab bars, towel racks and similar items. Interior angles shall be reinforced with supports to provide rigid corners.

Where pipes, valves and other items penetrate the gypsum wallboard the hole cut to accommodate them shall not be more than 3/8-inch away from the penetration at any given point.

Joints between adjoining pieces of water-resistant gypsum board shall be treated with a joint compound and tape, prior to the adhesive application of the tile. Gypsum board shall be kept free of any dirt, oil or other foreign matter which could cause a lack of bond. All joints should be even and true. The gypsum board shall be tight against framing members, with a maximum variation in the gypsum board surface not to exceed plus or minus 1/8-inch in 8 feet from the required plane.

Materials

Organic adhesives shall conform to ANSI A136.1-1967, Type 1.

Sealant shall be rubber silicone or polyurethane.

1. Commercial portland cement Dry--Set grout with additives. providing water retentivity for absorbent tile.
2. Regular commercial portland cement-type grout for vitreous and low absorbent tile.

PREPARATION BY TILE

1. Immediately prior to applying adhesive, the gypsum TRADE: board surface shall be brushed and wiped clean of all foreign substances and construction dust.
2. All openings around pipes and fixtures shall be sealed with sealant or adhesive, flush with the gypsum board surface.
3. Prior to the installation of first row of tile, a bead of sealant shall be applied at the vertical and the horizontal joints and legs of the tub or precast shower pan. Following the application of the tile, the same sealant shall be used at these joints in lieu of the cement grout tile joint.

The same sealant shall be used to fill the vertical in-corners which shall be kept free of all adhesive and grout.

4. The soap dish shall be set with the same organic adhesive used for setting the tile. The soap dish shall be backbuttered with the adhesive. Opening in the tile wall to receive the soap dish shall conform in size to the soap dish.

NOTE: Soap dish shall be surface type to eliminate necessity of cutting into the gypsum board.

5. The trowel for applying adhesive shall be 1/4-inch, but not less than 3/16-inch in depth, V-notch for glazed wall tile with slightly squared points to prevent tearing or scratching the gypsum board surface. For other types of tile, follow manufacturer's recommendations.
6. Before installing any ceramic tile the contractor shall inspect surfaces to receive tile and accessories. He shall notify the architect or other designated authority in writing of any defects or conditions that will prevent a satisfactory tile installation. Do not proceed with installation work until satisfactory corrections have been made. Starting of work implies acceptance of surfaces to receive tile.

PROTECTION and SAFETY REQUIREMENTS:

1. Tile may be set at low temperatures with adhesives; consult manufacturer of adhesives for specific temperatures. Maintain a temperature of 50 ° F or above during installation and curing of cement grouts.
2. Provide and operate safety spark-proof fan when natural ventilation is inadequate.
3. Smoking is prohibited when using adhesives containing inflammable volatile solvents.

WORKMANSHIP, CUTTING and PITTING

1. Install tile in a manner conforming with the best current practice of the industry.
2. Do not make an excessive amount of cuts. Usually, no cuts smaller than half size should be made, and areas of tile shall be centered and balanced. Make all cuts on the outer edges of the field.
3. Smooth all cut edges with a carborundum stone, and install no the with fagged or flaked edges.
4. Fit tile closely where edges will be covered by trim, escutcheons or other similar devices.
5. The splitting of tile is expressly prohibited except where no alternative is possible.
6. Maintain the heights of tilework in full course to the nearest obtainable dimension where the heights are given in feet and inches and are not required to fill vertical spaces exactly.
7. Make corners of all tile flush and level with corners of adjacent tile, with due allowance to watpage tolerances for tile as specified in ANSI A137.1-1967.
8. Keep all joint lines straight and of even width, including miters.
9. Finish wall areas level and plumb within ± 1/8-inch of true plane in 8 feet.
10. Install accessories in tilework so they are evenly spaced, properly centered with tile joints, and are level, plumb and true to the correct projection. Install accessories at locations and heights designated.
11. The finished tilework shall be clean and free of tiles which are pitted, chipped, cracked or scratched.

JOINT WIDTHS:

1. When tile are not self-spacing, maintain uniform joints, plumb..., true and even, and in accordance with the following widths:

Mounted tale 2-3/16-inches
square or smaller 1/32 to 7/64-inch

Mounted tile over 2-3/16
inches square 1/16 to 1/4-inch

Unmounted unglazed tile
from 2-3/16 to 4-1/4
inches square 1/16 to 1/4-inch

Unmounted unglazed tile
6 by 6 inches and over 1/4 to 1/2-inch

Quarry tile unmounted 1/4 to 1/2-inch

Glazed tile 3-inches
square and over 1/16 to 1/4-inch

Faience tile in all sizes 1/8 to 1/2-inch

ADHESIVE APPLICATION:

Spread adhesive on surface to be tiled with notched trowel of type as recommended by the manufacturer for the surface and type of tile. Cover surface uniformly with no bare spots. Apply adhesive only in areas which can be covered with tile before the adhesive films over. Remove any adhesive that films over and refloat with fresh adhesive.

SETTING TILE ON WALLS and CEILINGS:

1. Press individual tile or sheets of tile into the adhesive, using care to maintain accurate joint alignment and spacing.
2. Beat-in tile with a rubber-faced beating block to obtain maximum contact between the tile backs and adhesive. The average contact area of adhesive on tile or tile assembly removed for inspection shall be 80 percent or more and no individual tile or tile assembly shall have less than 50 percent coverage of adhesive.
3. Remove paper and glue from paper-mounted ceramic mosaics before the adhesive is firmly set and align individual tile as required.

PREPARATION FOR GROUTING:

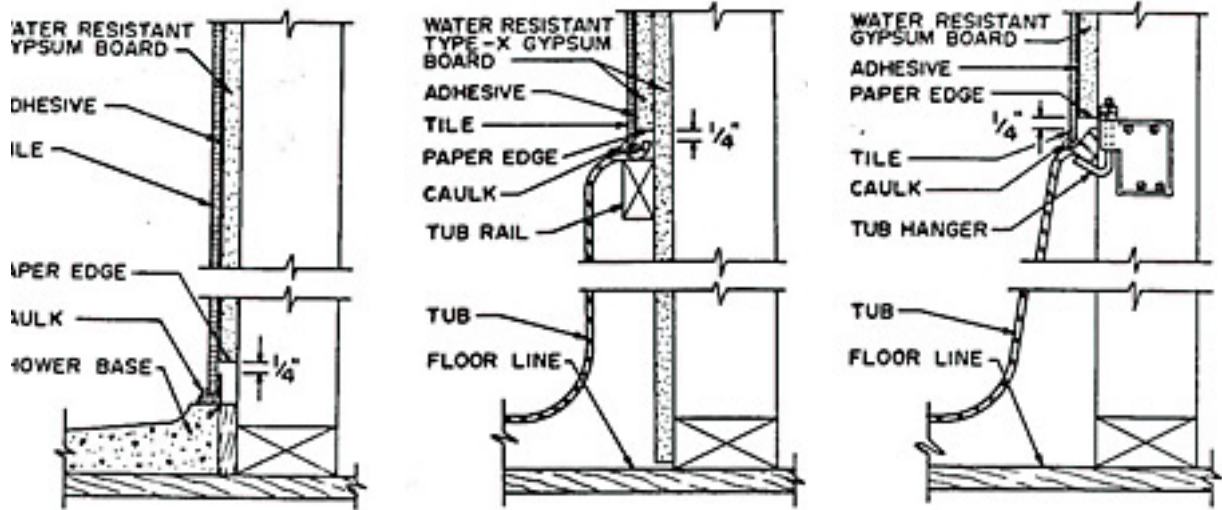
1. Carefully and completely remove all adhesive from front of edge and face of tile. Use only solvents recommended by adhesive manufacturer. Avoid use of excess solvent. Ventilate and take fire precautions as recommended by the adhesive manufacturer. Allow a minimum of 48 hours for evaporation of solvent before grouting unless otherwise recommended by the adhesive manufacturer.
2. After the paper has been removed from ceramic mosaics make certain that all glue is removed before applying grout.

GROUTING and CURING:

1. If strings or ropes were used to space tile, remove TILE before grouting but not until mortar has set.
2. Follow proprietary grout manufacturer's directions and damp cure as needed to produce a hard grout.
3. Thoroughly soak glazed wall tile before grouting TILE with ordinary portland cement grout.
4. Remove all glue from face of ceramic mosaics before grouting.
5. Force maximum of grout into joints. Use grout of type and mix as hereinbefore specified and follow grout manufacturer's direction explicitly.
6. Before grout sets, strike or tool the joints of cushion-edge tile to depth of cushion. Fill all joints flush with surface of square-edge tile.
7. Fill all gaps and skips. The finished grout shall be uniform in color, smooth and without voids, pin holes or low spots.
8. Sponge and wash tile thoroughly, diagonally across joints. Finally polish with clean, dry cloths.
9. Cure portland cement grouts by keeping damp for at least 72 hours. Cure Dry-Set grouts in wet locations by keeping damp for at least 72 hours. Add dampness as needed. Covering with polyethylene sheeting facilitates curing of grout.

CLEANING TILE:

1. Upon completion of setting and grouting, sponge and wash the thoroughly, diagonally across joints. Finally polish with clean, dry cloths.
2. Do not use acid or acid cleaners to clean glazed tile.
3. Acid cleaning of unglazed tile shall not be done before 10 days after setting. Wet tile with water before cleaning with sulfamic acid and follow directions of the acid manufacturer: Protect all metal and enameled iron with grease. Flush thoroughly with water after acid cleaning.



SMITH-EMERY COMPANY

File No: 819
 Laboratory No: L-75-1911-A

Date: January 29,
 1976
 Order No: 2430-T

Ceramic Tile Institute
 700 N. Vigil Avenue
 Los Angeles, California
 90029

SUBJECT:

SHEAR TESTS OF CERAMIC TILE BONDED TO
 GREEN GYPSUM BACKER BOARD TYPE II AND
 TYPE I ADHESIVE

REPORT OF TESTS

PROCEDURE:

THE BONDING MORTAR WAS APPLIED TO THE GREEN FACE OF THE GYPSUM BOARD WITH A NOTCHED TROWEL AND 4-1/4X4-1/4 CERAMIC TILE WAS APPLIED. THE SAMPLES WERE TESTED AT THE AGE OF 60-DAYS AFTER BONDING.

Type II Adhesives

<u>Sample No.</u>	<u>Area Sq. In.</u>	<u>Load Pounds</u>	<u>PSI</u>	<u>Result</u>
1	18.06	1120	62	Failure occurred at bond between brown and green paper.
2	18.06	900	50	Failure occurred at bond between brown and green paper.

3	18.06	1260	70	Failure occurred at bond between brown and green paper.
4	18.06	980	54	Failure occurred at bond between brown and green paper.
			—	
Average			59	

Type I Adhesives

<u>Sample No.</u>	<u>Area Sq. In.</u>	<u>Load Pounds</u>	<u>PSI</u>	<u>Result</u>
1	18.06	1800	100	Failure occurred at bond between brown and green paper.
2	18.06	1640	91	Failure occurred at bond between brown and green paper.
3	18.06	1520	84	Failure occurred at bond between brown and green paper.
4	18.06	1560	86	Failure occurred at bond between brown and green paper.
			—	
Average			90	

File No: 819-75
Laboratory No: L-75-1911-B

Date: December 15, 1975
Order No: 2430-T

Ceramic Tile Institute
700 N. Vigil Avenue
Los Angeles, California
90029

SUBJECT: SHEAR TESTS OF CERAMIC TILE BONDED TO GREEN GYPSUM BACKER BOARD WITH LATEX AND DRY-SET PORTLAND CEMENT MORTAR.

REPORT OF TESTS

PROCEDURE: THE BONDING MORTAR WAS APPLIED TO THE GREEN FACE OF THE GYPSUM BOARD WITH A NOTCHED TROWEL AND 4-1/4X4-1/4 CERAMIC TILE WAS APPLIED. THE SAMPLES WERE TESTED AT THE AGE OF 7-DAYS AFTER BONDING.

Latex Cement Mortar

<u>Sample No.</u>	<u>Area Sq. In.</u>	<u>Load Pounds</u>	<u>PSI</u>	<u>Result</u>
1	18.06	2000	111	Failure occurred at bond between brown and green paper.

2	18.06	1940	108	Failure occurred at bond between brown and green paper.
3	18.06	1920	107	Failure occurred at bond between brown and green paper.
4	18.06	2100	117	Failure occurred at bond between brown and green paper.
5	18.06	1880	104	Failure occurred at bond between brown and green paper.

Average

109

Thin-Set (white) Mortar

<u>Sample No.</u>	<u>Area Sq. In.</u>	<u>Load Pounds</u>	<u>PSI</u>	<u>Result</u>
1	18.06	1520	84	10% bond or mortar to tile, 90% bond between green and brown paper.
2	18.06	1860	103	10% bond or mortar to tile, 90% bond between green and brown paper.
3	18.06	1900	106	80% bond of mortar to tile, 20% bond between green and brown paper.
4	18.06	1520	84	Board fracture around tile.
5	18.06	1900	106	65% bond of mortar to tile, 35% bond between green and brown paper.

Average

97

File No: 819-75
Laboratory No: L-75-1911-B

Date: December 15, 1975
Order No: 2430-T

Ceramic Tile Institute
700 N. Vigil Avenue
Los Angeles, California 90029

SUBJECT: WATER PENETRATION TEST THROUGH BONDING MATERIALS
USING U.S.G. WATER RESISTANT GYPSUM BOARD.

REPORT OF TESTS

1. Adhesive Type I installed in accordance with ANSI A108.4.
2. Adhesives Type II installed in accordance with ANSI A108.4.
3. Latex Portland Cement Mortart installed in accordance with ANSI A108.5.

4. Different Brand Latex Portland Cement Mortar installed in accordance with ANSI A108.5.
5. Thin Set Portland Cement Mortar installed in accordance with ANSI A108.5

PROCEDURE:

FOUR (4) GLAZED CERAMIC TILES WERE BONDED TO 12X12 PIECES OF THE U.S.G. WATER RESISTANT GYPSUM BOARD AND GROUTED WITH CUSTOM'S WHITE TILE GROUT, DRY. TWO SPECIMENS WERE MADE OF EACH BONDING MATERIAL. SPECIMENS WERE CURED FOR FOURTEEN DAYS AT ROOM TEMPERATURE BEFORE A 611 HIGH COLUMN OF WATER WAS APPLIED TO EACH SPECIMEN. RESULTS TO BE OBTAINED BY WEIGHING SPECIMENS 13 BEFORE THE TESTS WERE STARTED AND AT INTERVALS LISTED IN REPORT TO RECORD POSSIBLE GAINS IN WEIGHT. RESULTS ARE FOUND ON ATTACHED PAGE (2).

<u>PERCENTAGE OF GAIN IN WEIGHT</u>						
Identification of Material	72 Hours	7-Days	14-Days	21-Days	28-Days	35-Days
#1-A	1.05	0.91	0.81	1.00	0.95	0.91
B	0.63	0.80	0.80	0.63	0.63	0.71
Average	0.84	0.86	0.81	0.82	0.79	0.81
#2-A	0.36	0.40	0.54	0.63	0.63	0.72
B	0.50	0.54	0.50	0.36	0.32	0.32
Average	0.43	0.47	0.52	0.50	0.48	0.52
#3-A	0.64	0.64	0.64	0.64	0.68	0.64
B	0.36	0.45	0.32	0.32	0.36	0.36
Average	0.50	0.55	0.48	0.48	0.52	0.52
#4-A	0.70	0.70	0.70	0.70	0.70	0.65
B	0.94	0.89	0.89	0.85	0.85	0.89
Average	0.82	0.80	0.80	0.78	0.78	0.77
#5-A	0.45	0.50	0.36	0.45	0.41	0.41
B	0.63	0.49	0.49	0.45	0.49	0.49
Average	0.54	0.50	0.43	0.45	0.45	0.45