



June 2, 2009

Ms. Fatma M. Amer, P. E.
First Deputy Commissioner
NYC Department of Buildings
280 Broadway, 7th Floor
New York, NY 10007

Re: National September 11 Memorial and Museum – Parapet Design

Dear Commissioner Amer:

Thank you for the meetings on April 16 and May 11, 2009, to discuss the design of the parapet around the Memorial pools at the World Trade Center.

Based on your suggestions at the April 16th meeting, the parapet design was modified at the corners to meet the accessibility requirements in the code, and was presented to you again on May 11th. Sight-line studies on the modified design by Davis Brody Bond Aedas, the architects for the project, shows that the front view for the people on wheel chairs from the corners is equivalent to the view for others standing around the perimeter of the pools. In addition to the corners, the entire pool perimeter will be accessible for parallel viewing to achieve similar level of visibility.

Subsequent to our meetings, the Department of Buildings review has concluded that the modified design provides for 2 wheelchair front viewing positions at each of the four chamfered corners, for a total of 8 spaces at each pool, which meets the requirements in 2008 Building Code Section 1108.2, based on the following calculations:

Each side of the pools is approximately 200 feet or 2,400 inches
2,400 inches divided by 22 inches equals 109 standees per side
 $4 \times 109 = 436$ total standee capacity. Based on Table 1108.2.2.1, 6 wheelchair spaces are required. This is the code minimum requirement.
Considering a 2nd row of standees, the total number of people comes to $436 \times 2 = 872$.

The proposed 8 wheelchair front viewing positions are in addition to the parallel viewing locations available along the entire perimeter of each pool. Such arrangement will afford the wheelchair users the same viewing experience of people standing around the pool.

Gateway 3
100 Mulberry Street
Newark, NJ 07102



THE PORT AUTHORITY OF NY & NJ

Ms. Fatma M. Amer, P. E.

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Furthermore, in the absence of specific standards or guides for sightline, the sightline analysis provided by Davis Brody Bond Aedas, pursuant to Title 28 Section 104.7.11, is satisfactory to the Department in demonstrating due diligence and that the proposed viewing locations meet the code minimum requirement. Accordingly, a waiver recommendation from the Mayor's Office for the Physically Disabled is not required.

The documents listed below were discussed at the meetings and are attached:

- Handel Architects Sketch P-1 for the modified design, dated 5/05/09
- Letter to the Port Authority, dated 4/30/09, from Davis Brody Bonds Aedas, enumerating the sightline analysis with accompanying sketches for the modified design
- Sightline Studies for the Original Scheme, dated 3/27/09

Also, attached are the meeting attendance records of the April 16th and May 11th meetings.

If you find the above to be a fair and accurate summary of our meetings and understandings, and concur that the modified design meets the code requirements, I would appreciate your concurrence at the bottom of the letter and return of one copy.

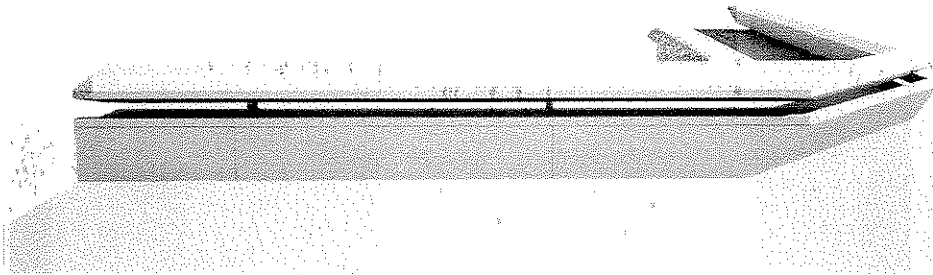
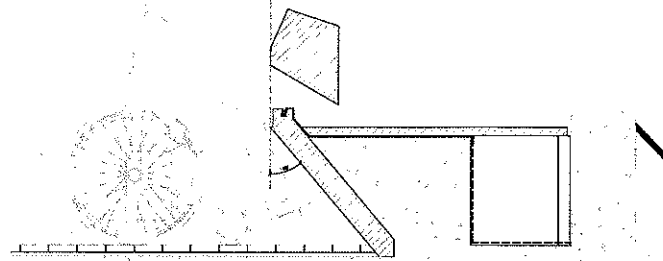
Very truly yours,

Saroj Bhol, P. E.
Manager, Construction Design Standards

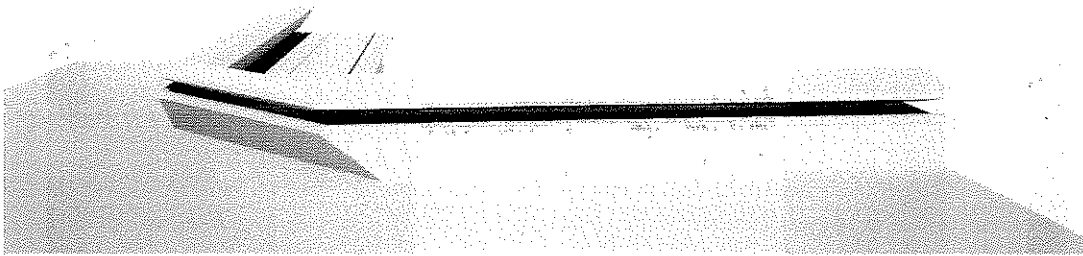
Concurred:

Fatma M. Amer, P. E.
First Deputy Commissioner

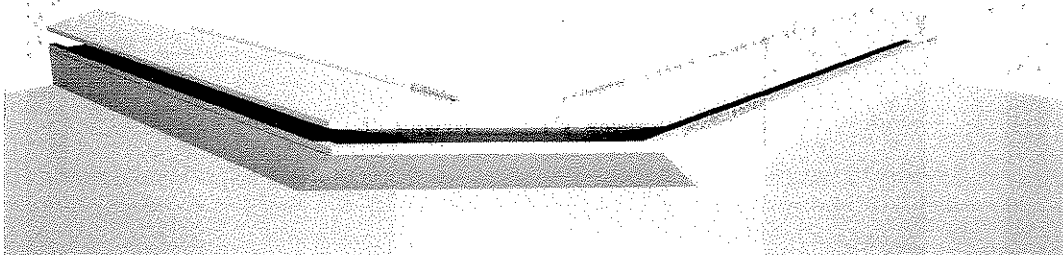
OPTION A-40



OPTION A - 40



OPTION A - 40



OPTION A - 40

Davis Brody Bond Aedas

30 April 2009

Mr. Saroj Bhol,
Port Authority of New York and New Jersey
Quality Assurance Division

Dear Mr. Bohl:

Thank you for arranging our meeting on April 10th to review the proposed names parapet of the memorial with you and the NYC Department of Buildings. We have relayed your comments to Michael Arad who has responded with a revised design, specifically one that addresses the frontal viewing position of someone in a wheelchair from the corners of the pools. The attached sketches show sightline analyses for a revised parapet corner condition which responds to your request.

The proposed design creates a space beneath a sloping parapet which allows a wheelchair to come much closer than is possible with the vertical parapet. The controlling feature in this design is the knee of the wheelchair occupant, which touches the front of the parapet and sets the closest viewing dimension.

Criteria for Sightline Analysis

To evaluate this solution it was first necessary to determine the appropriate anthropometric dimensions for knee to eye distance. In the process of defining this dimension it became clear that there is no single official standard for wheelchair occupants' measurements and that this specific dimension (knee to eye) did not readily exist. Therefore the study's sources for dimensions, and how they were derived, are referenced below.

More critically, from the available literature it became clear that the evaluation of the proposal should not only analyze its performance relative to an "average" individual, but also human dimensions at the 5 and 95 percentile. These percentiles are typically provided with the anthropometric data.

For establishing male and female eye heights in wheelchairs there are a number of sources and studies. Several of them are referenced below and the differences between them for this dimension are minor. One should note that all these sources seem to be based on a standard wheelchair seat height of 19" and do not incorporate an evolving range of scooters and other devices.

Finally, we were unable to find the precise dimension that is set from the front of the knee to the eye. However a database of human dimensions was identified which allowed us to derive this number as the difference between two separate measurements. Because this is a different source than the one we used for the eye height dimension, and because it was not derived from a sample of wheelchair users, there may be some concern about variation and applicability. To address this, the sightline studies have added a one inch setback from the parapet edge to the wheelchair as a contingency factor. This one inch setback also addresses issues of comfort as visitors may not want their knee touching the parapet when viewing

Davis Brody Bond, LLP
Architects and Planners
315 Hudson Street
New York, NY 10013

Tel +1.212.633.4700
Fax +1.212.633.4760
info@davisbrodyaedas.com
www.davisbrodyaedas.com

Davis Brody Bond Aedas

NS11Memorial and Museum DBB 20422

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the pool.

Findings

The results of the sightline studies indicate that mean (50 percentile) male and female wheelchair user have a view of the lower pools from the corners that is comparable to that of standing visitors elsewhere around the pool edge. This would also be the case for the 95 percentile of men and women.

For wheelchair users who are considerably shorter than the mean (i.e. 5 percentile) it will be difficult to achieve a view into the pools comparable to that afforded able bodied individuals. Because of the eye level of these individuals (for example: female eye height at 42.7") it is difficult to look down into the void (though they are still able to see the waterfalls) and still maintain the code required 42" high guard around its edge. However, from the studies of the view achieved at the 50 percentile, one can reasonably conclude that the overall majority of male and female wheelchair users would have a viewing experience comparable to that of able bodied individuals.

As we discussed in our prior meeting and submission, the critical visitor objectives of seeing and touching the names, touching the water, and circumnavigating the pools have been addressed for all visitors. A visitor's encounter with the memorial is the sum of a number of interconnected experiences of which the view into the pools is only one.

Upon your review, we would be eager to discuss any questions you may have, as well as those of the NYC DOB. We are available at your earliest convenience.

Sincerely,



Carl Krebs
Partner

Attachments: Attachment 1- Sources
Sightline Sketches

cc: Joan Gerner- NS11MM
Richard Franklin-DBBA

Davis Brody Bond Aedas

NS11Memorial and Museum DBB 20422

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Attachement 1

Sources

Four US sources suggest relatively close numbers for the average eye level of both male and female wheelchair users. The variations are slight and would not substantially affect the extent of view into the lower pools. Three sources identify an average, and a fourth provides the 5th, 50th and 95th percentiles. For the purposes of this parapet analysis, the 5th, 50th and 95th percentiles for men and women (Source 2) were used.

1. Eye Level for Wheelchair Users- Sources of Data

Source 1: Architectural Graphic Standards (7th Edition) 1981

Average Male Eye Level	48.6"
Average Female Eye Level	46.3"

Source 2: Floyd, W. F., et al. (1966). "A study of the space requirements of wheelchair users." *Paraplegia*, 4(1).

50% Male Eye Level	48.1"
95%	51.5"
5%	44.7"
50% Female Eye Level	46.4"
95%	50.1"
5%	42.7"

Source 3: Court Settlement United States of America vs. Ellerbe Becket

United States of America vs. Ellerbe Becket (US District Court, District of Minnesota, Fourth Division, Civil Action no. 4-96-995) regarding design of sports arenas.

Exhibit B "The average anthropometric dimensions employed shall be; (1) average eye height for a person sitting in a wheelchair is 47.45". "

(Note this is also the average of male and female of Source 1 Architectural Graphic Standards).

Source 4: Universal Design a Manual for Practical Guidance for Architects, Selwyn Goldsmith, Architectural Press, 2000.

Average Male Eye Level	48.2" (1225 mm)
Average Female Eye Level	45.5" (1155 mm)

Note: This anthropometric Data based on older studies.

2. Determination of Distance between Eye and Front of Knee

We were not able to find the distance between the eye and the front of the knee in a seated position was not located as a specific dimension, nor could we find specific data available derived from wheelchair users. This dimension has therefore been derived from anthropometric measurements of the able-bodied as the difference between two separate dimensions:

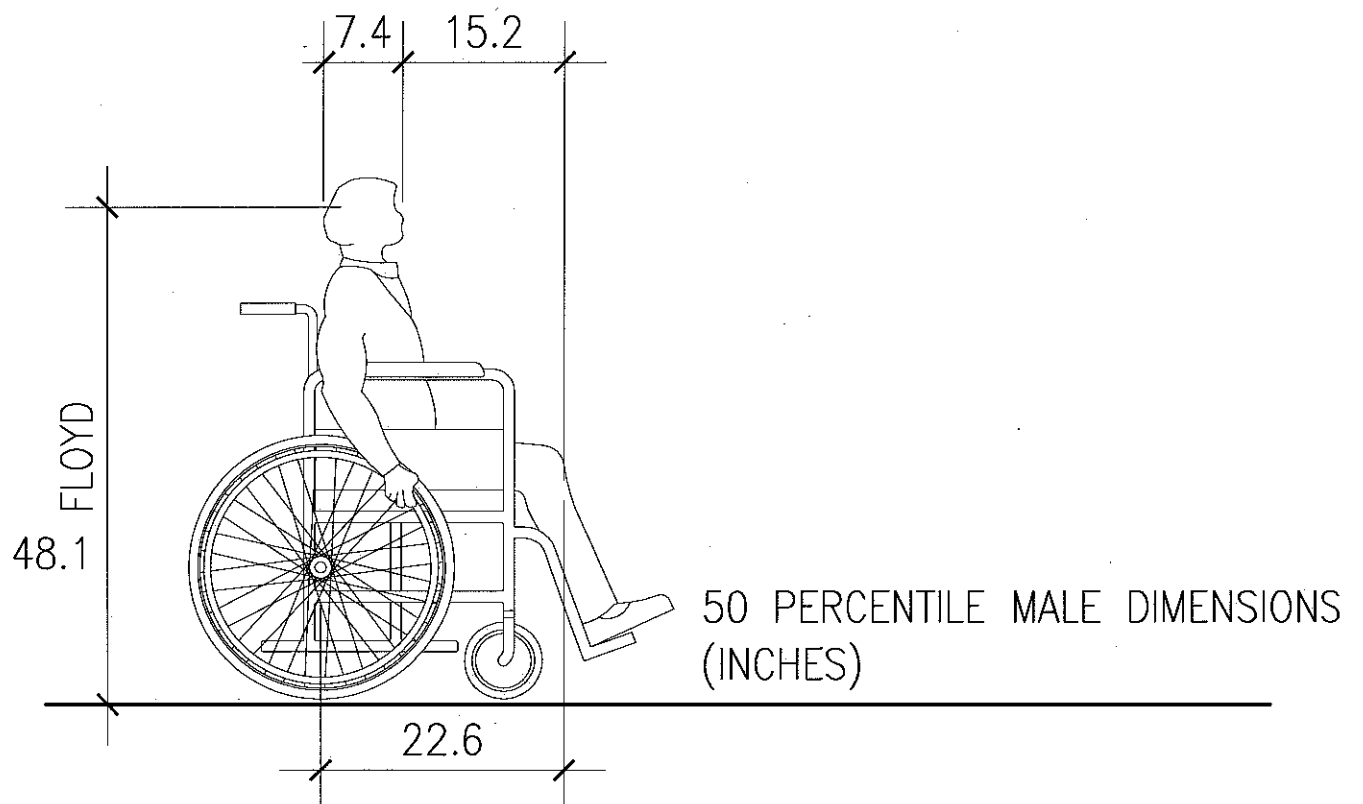
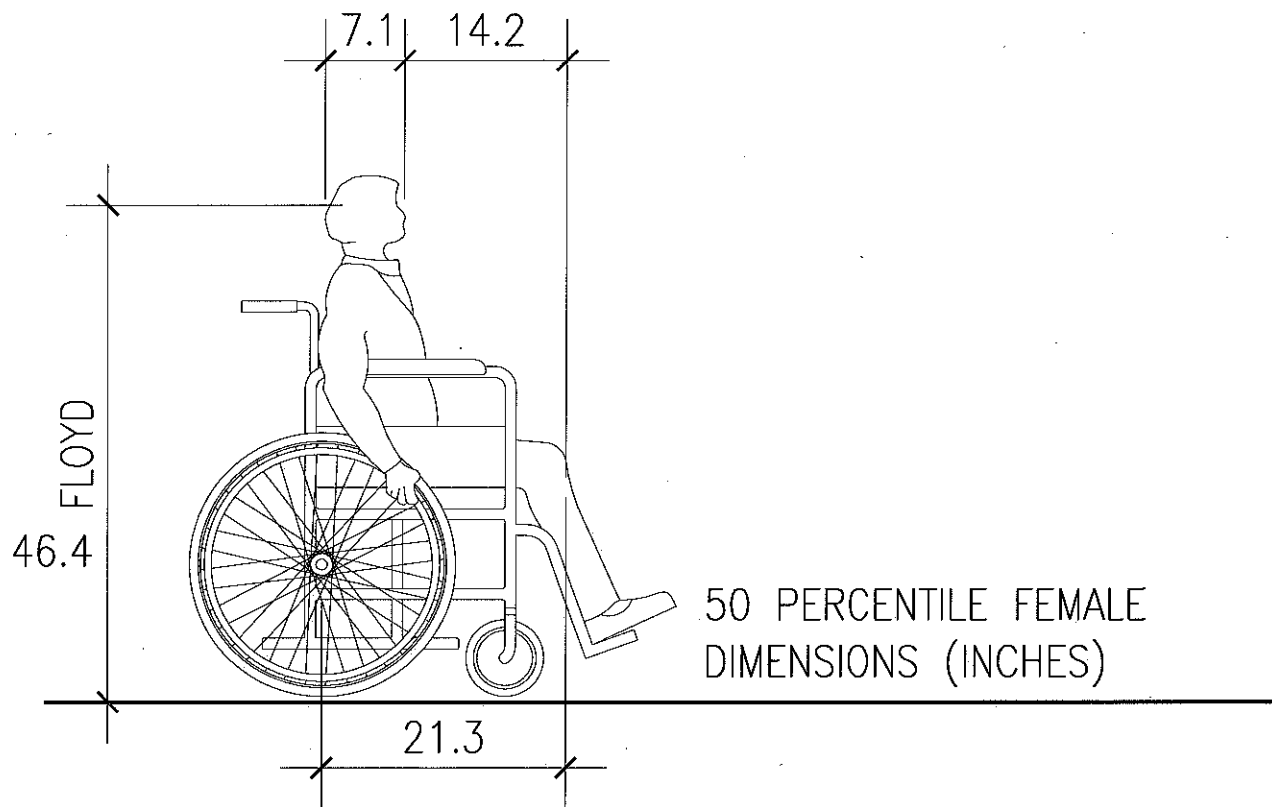
- Buttock to Knee Length, and
- Distance from back of head to eye

(The following dimensions are from The National Institute of Advanced Industrial Science and Technology, Digital Human Research Center. ISO 7250: 1996 Basic human body measurements for technological design).

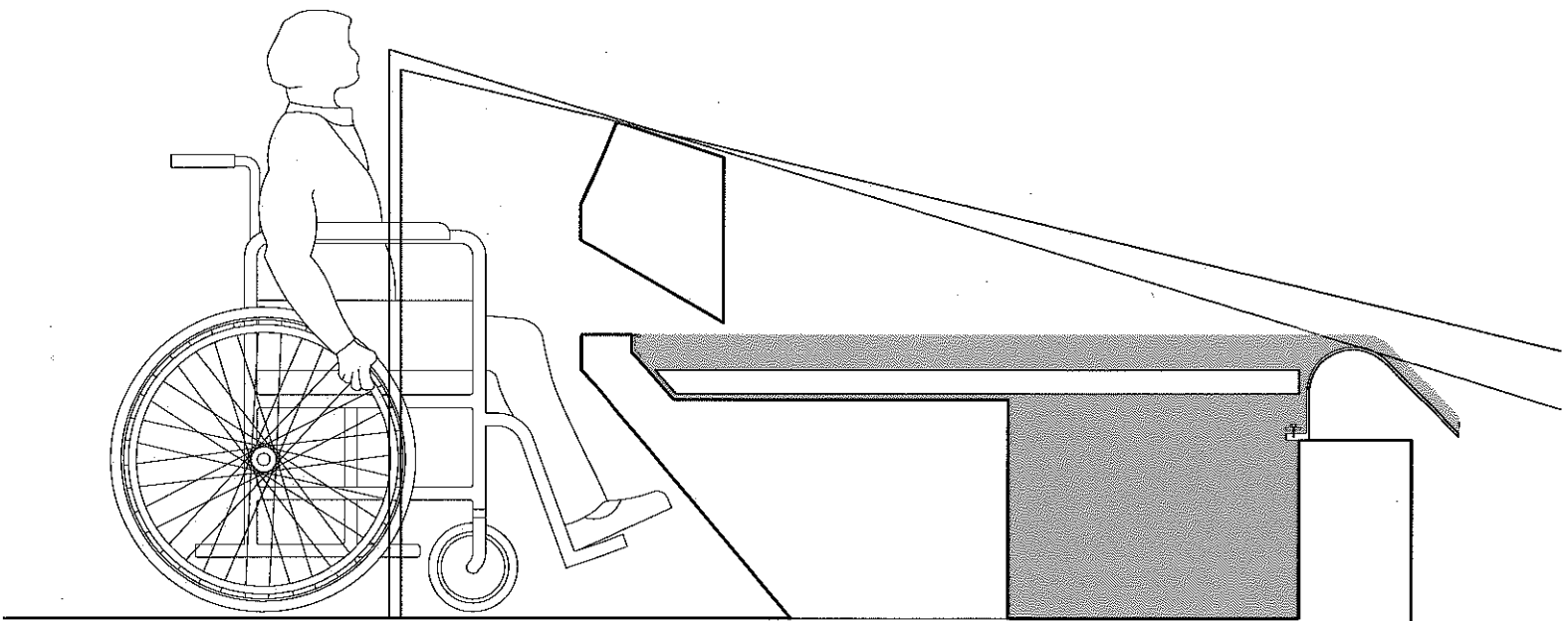
This data yields the following dimensions for the distance of the eye to the front of the knee.

	<u>Knee to Buttock</u>	<u>Back of Head to Eye</u>	<u>Horiz. Knee to Eye</u>
50% Male	22.6"	7.4"	15.2"
95%	24.3"	7.9"	16.4"
5%	21.0"	7.0"	14.0"
50% Female	21.3"	7.1"	14.2"
95%	22.8"	7.5"	15.3"
5%	20.1"	6.7"	13.4"

To address any concern about using different sources for vertical and horizontal dimensions in a sightline study. Therefore to adjust for any minor variances between the different sources (as well for the case that the eye to knee data was not specific to wheelchair users) all sight line calculations for the parapet add an additional inch in setback from the parapet as a contingency.



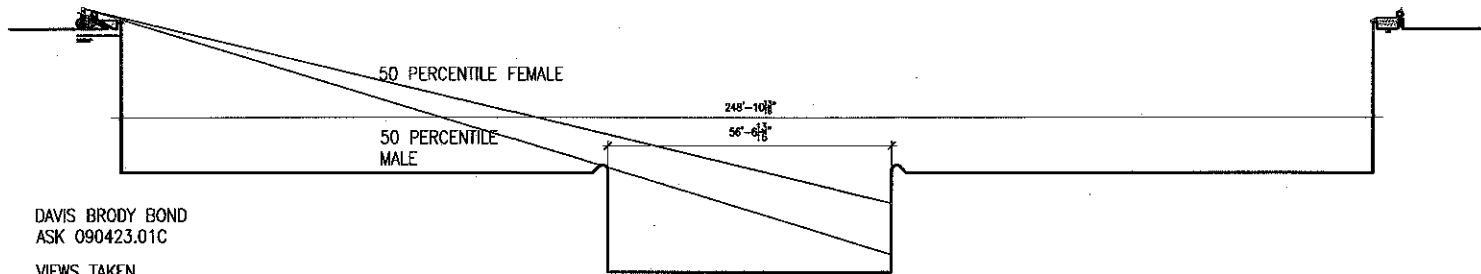
DAVIS BRODY BOND
ASK 090423.01A



50 PERCENTILE MALE & FEMALE AT PARAPET CORNER

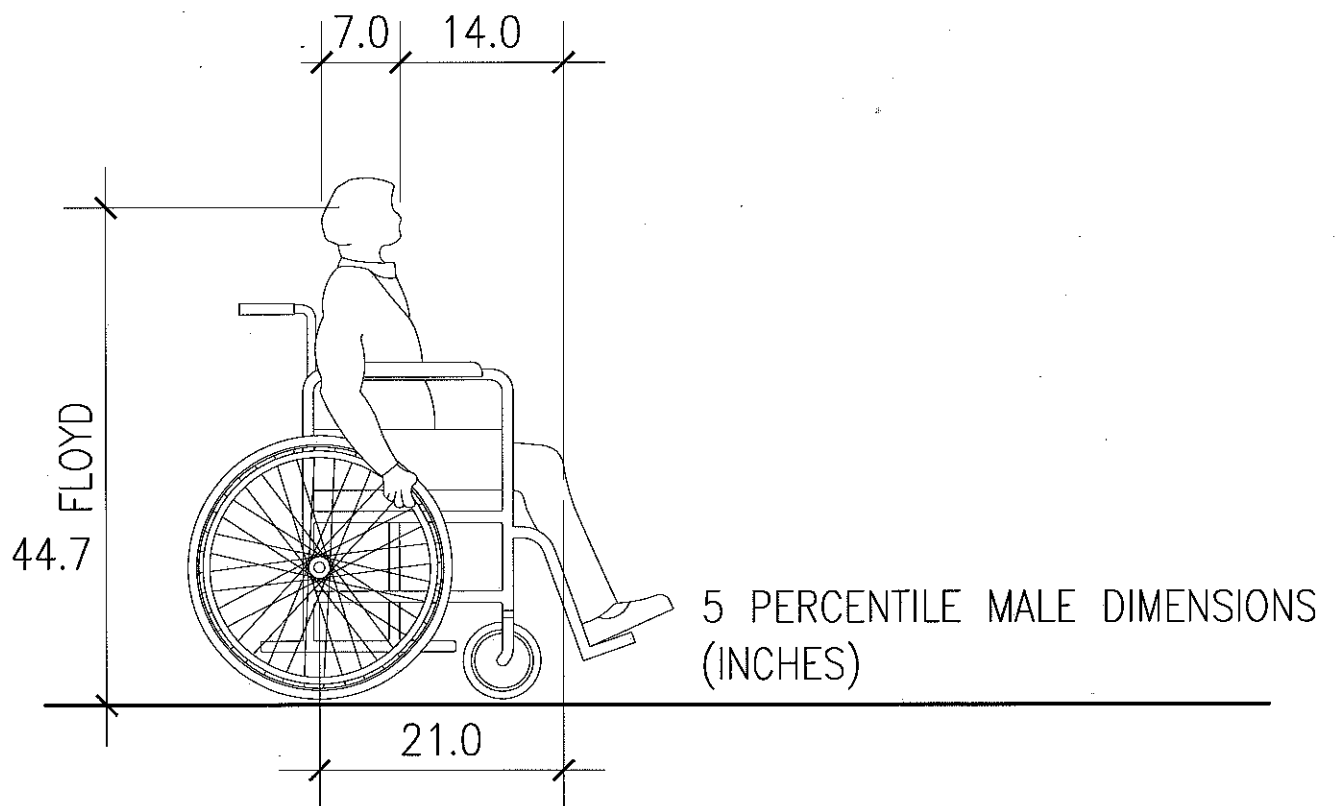
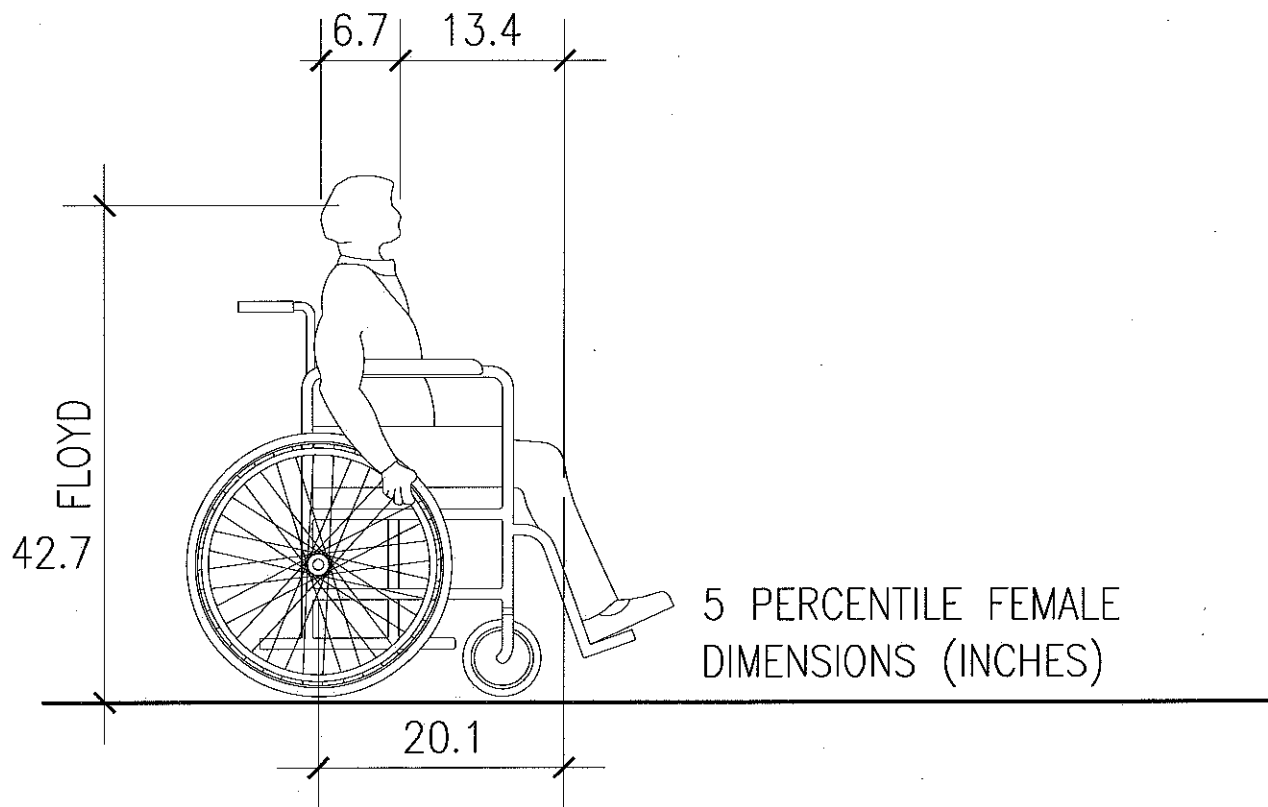
DAVIS BRODY BOND
ASK 090423.01B REV

50 PERCENTILE MALE & FEMALE SIGHTLINES

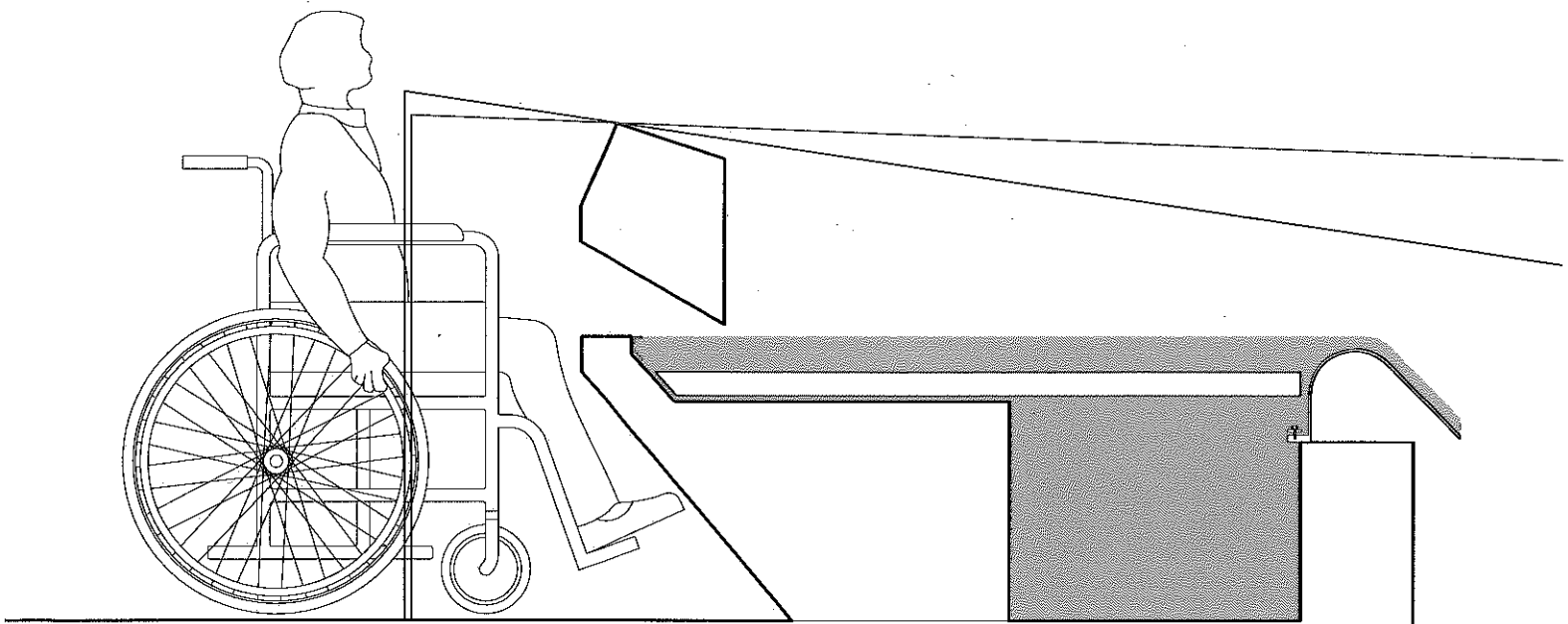


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VIEWS TAKEN
DIAGONALLY
ACROSS POOL



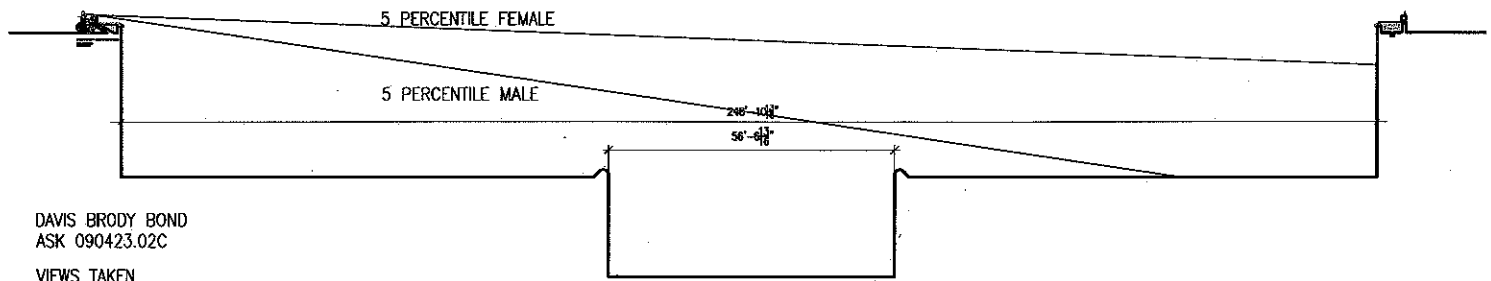
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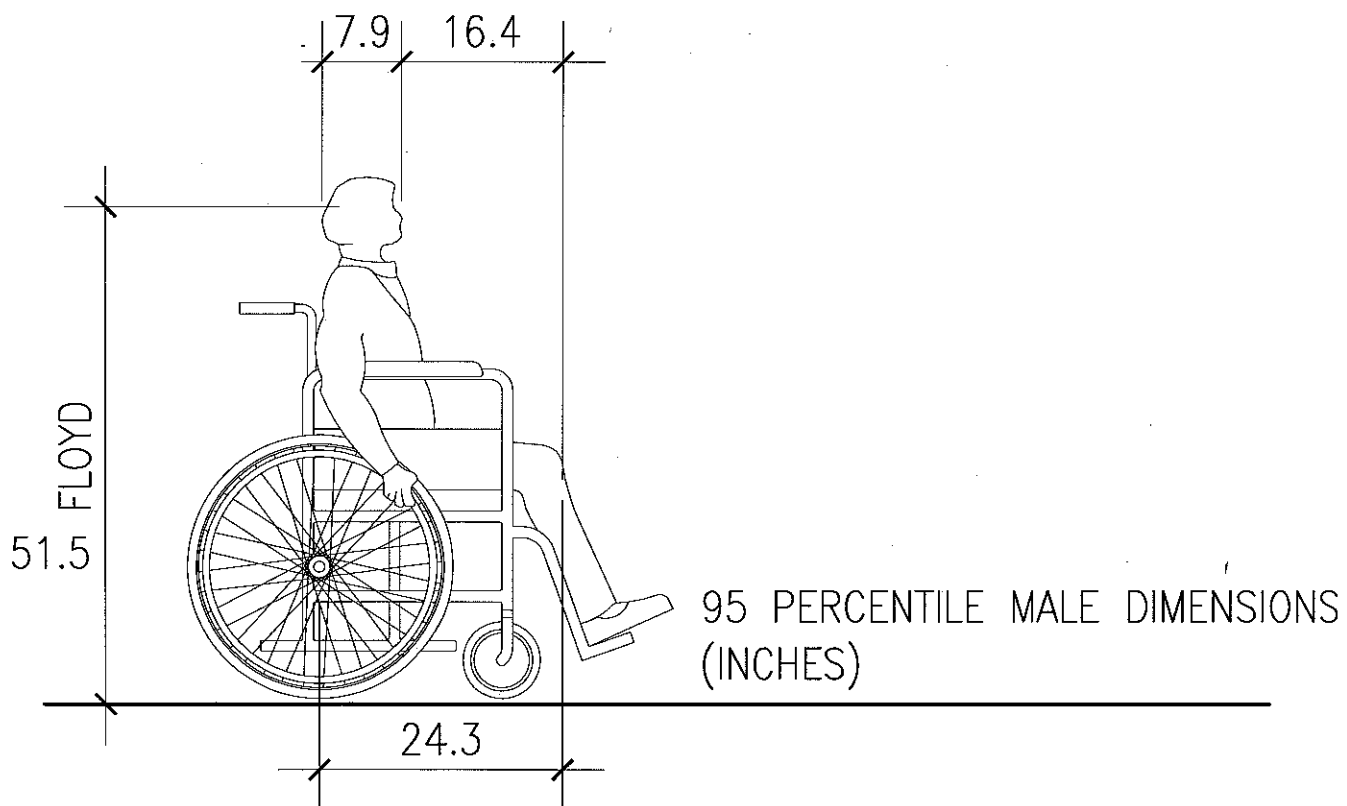
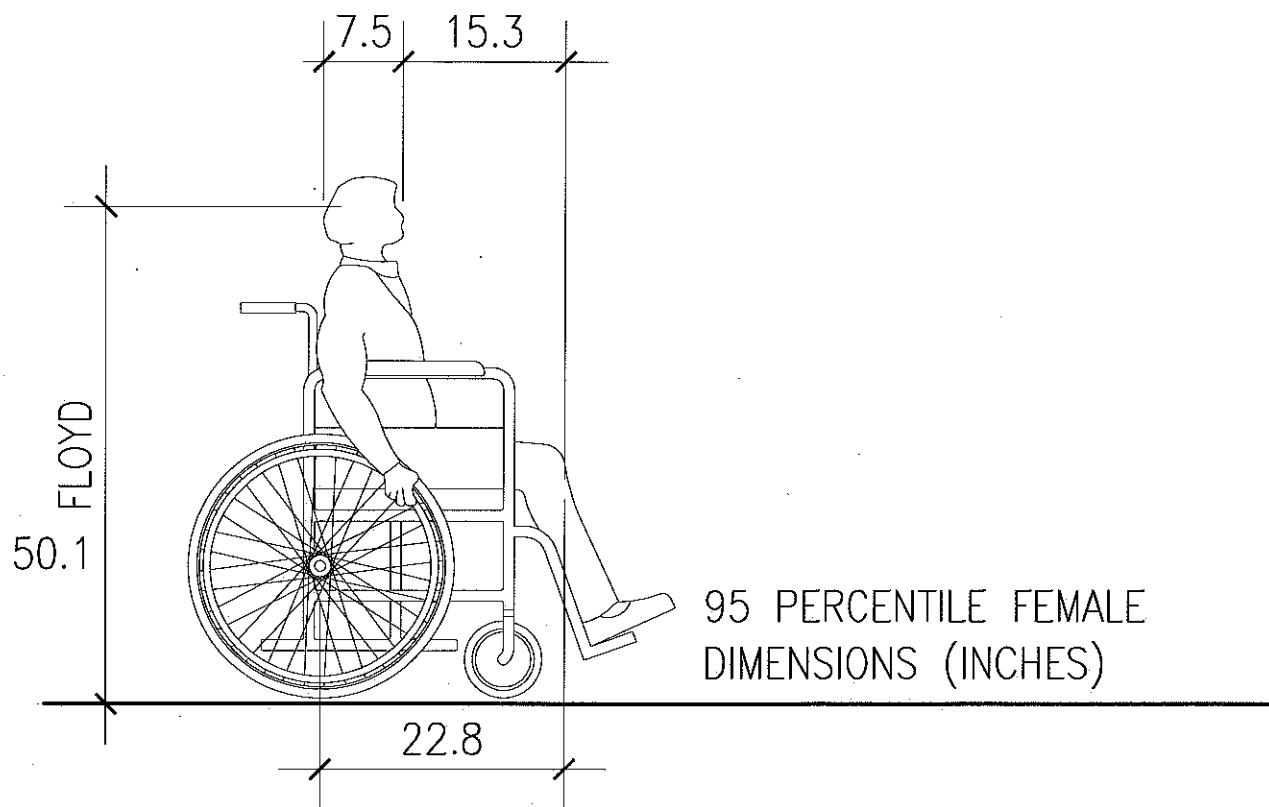
5 PERCENTILE MALE & FEMALE AT PARAPET CORNER

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ASK 090423.02B REV

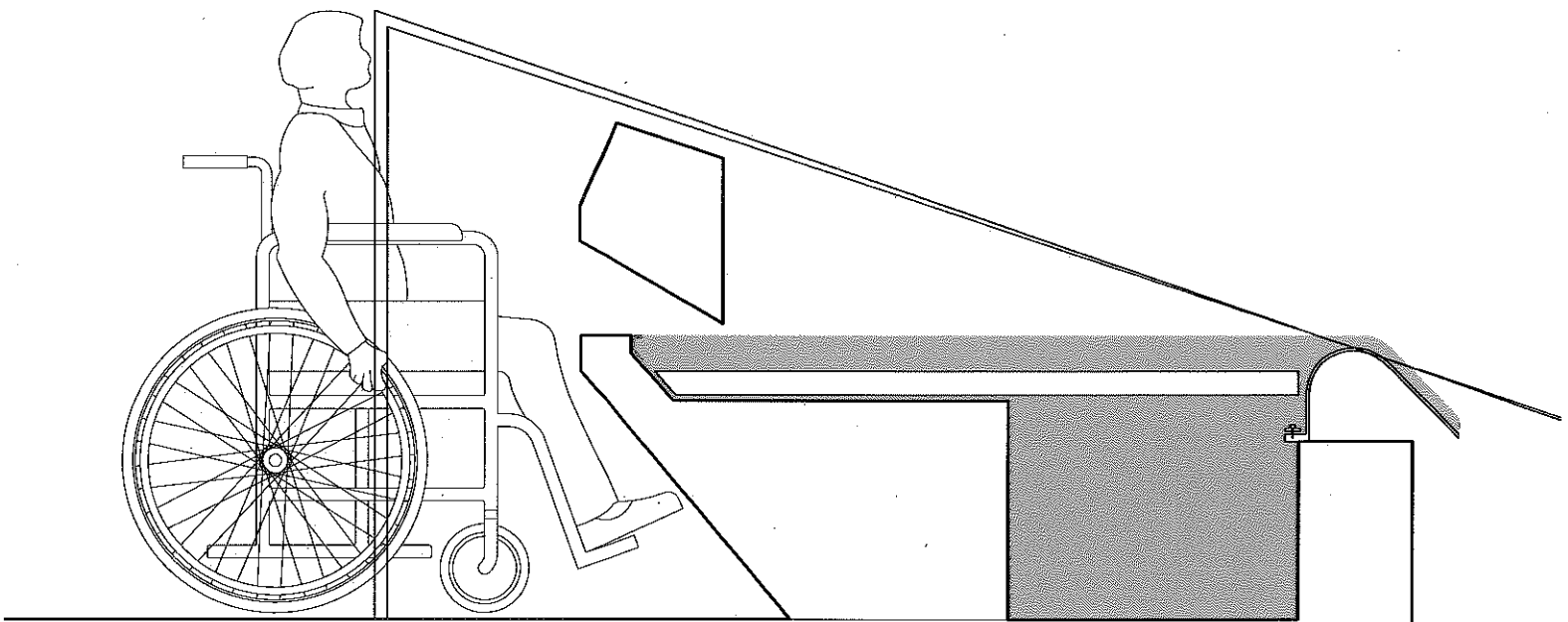
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VIEWS TAKEN
DIAGONALLY
ACROSS POOL



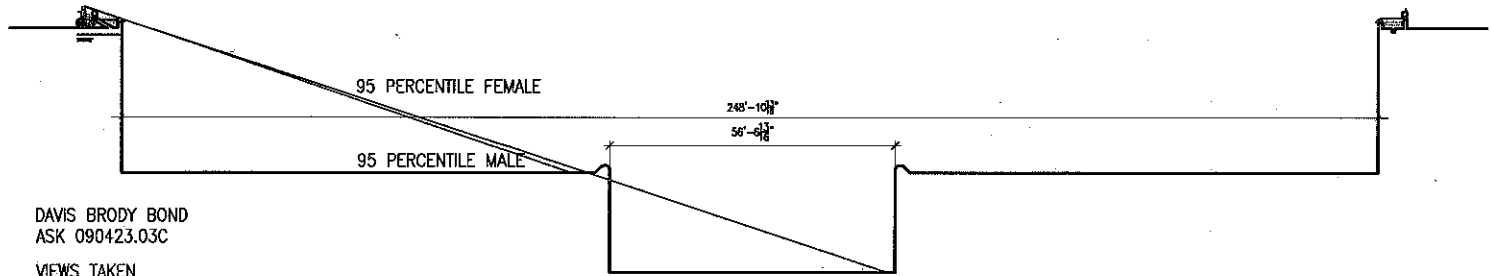
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95 PERCENTILE MALE & FEMALE AT PARAPET CORNER

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95 PERCENTILE MALE & FEMALE SIGHTLINES



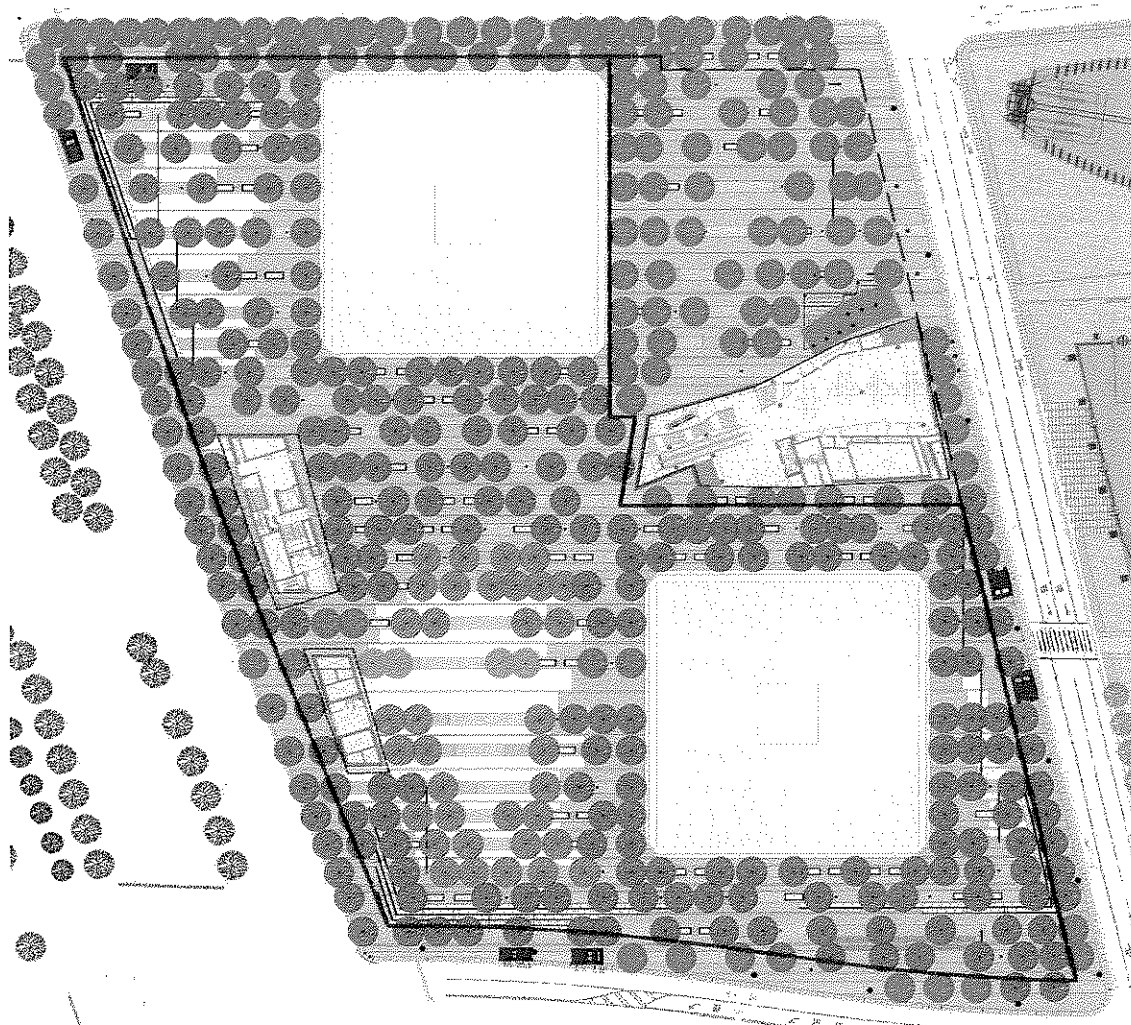
DAVIS BRODY BOND
ASK 090423.03C

VIEWS TAKEN
DIAGONALLY
ACROSS POOL

SIGHTLINES STUDIES

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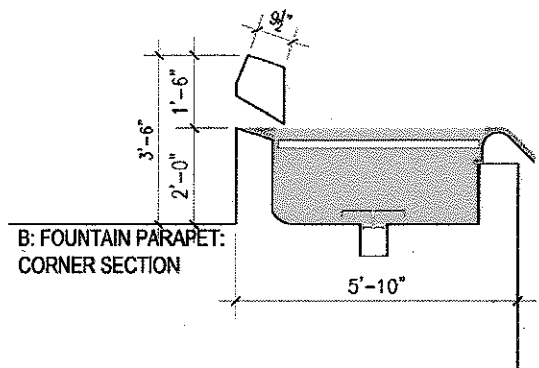
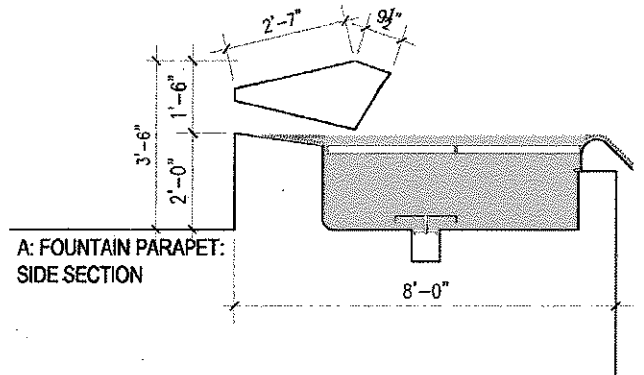
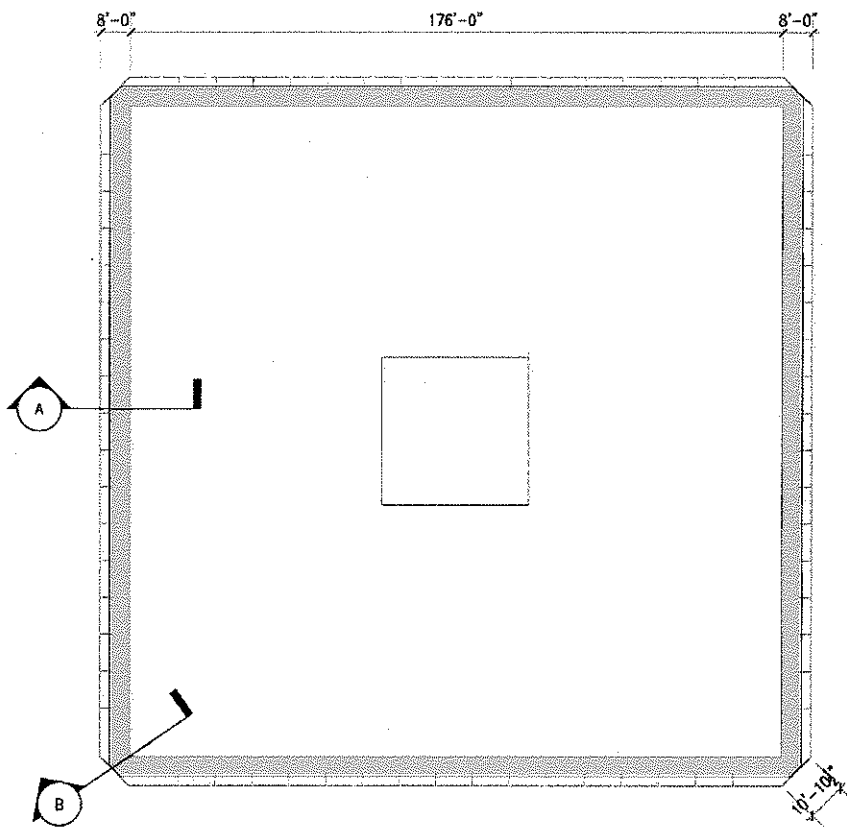
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ARCHITECTS AND PLANNERS



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MARCH 27, 2009

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ARCHITECTS AND PLANNERS
ASK.032709.01

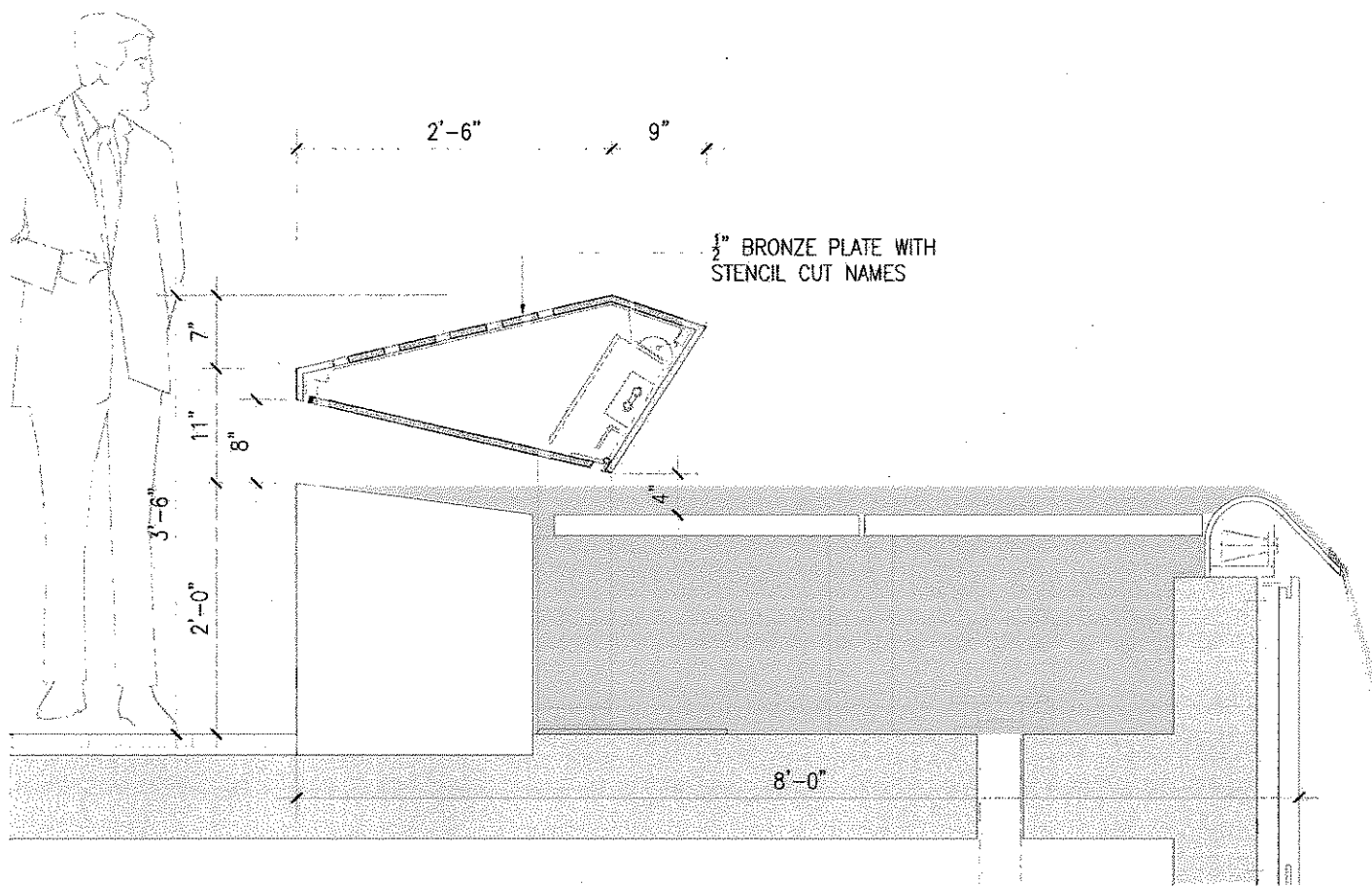
PLAZA PLAN



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MARCH 27, 2009

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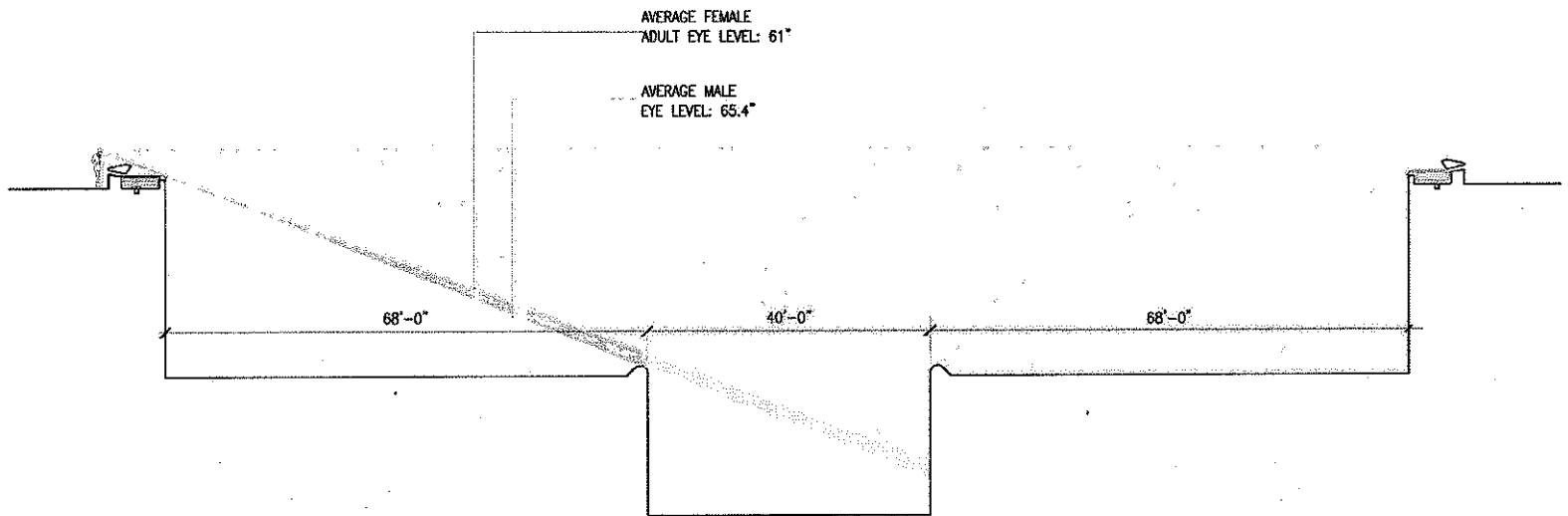
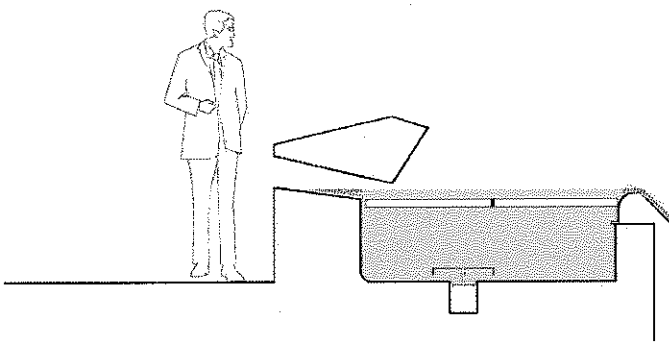
TYPICAL POOL AND EDGE CONDITION



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ASK.032709.03

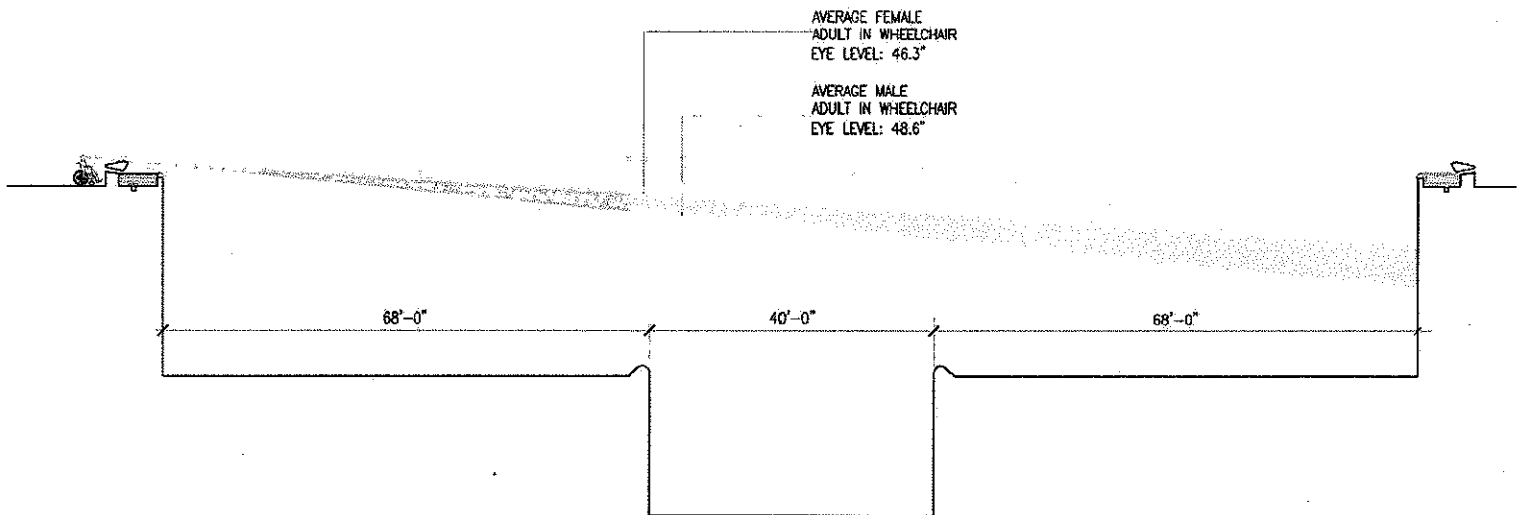
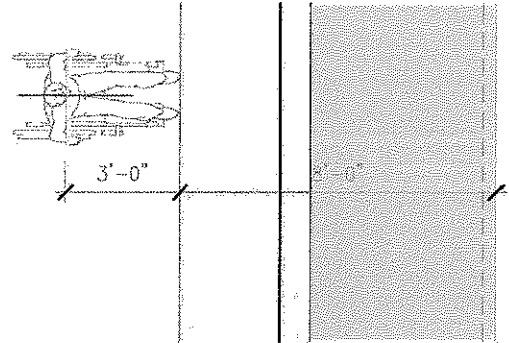
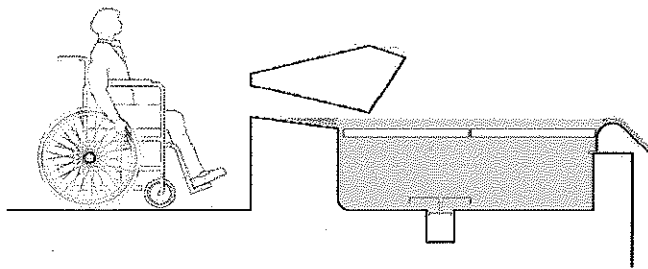
DETAIL OF PROPOSED MOCK-UP REPRESENTING
OVERALL DESIGN DIMENSIONS (NOT REPRESENTATIVE OF
FINAL CONSTRUCTION DETAILING)



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MARCH 27, 2009

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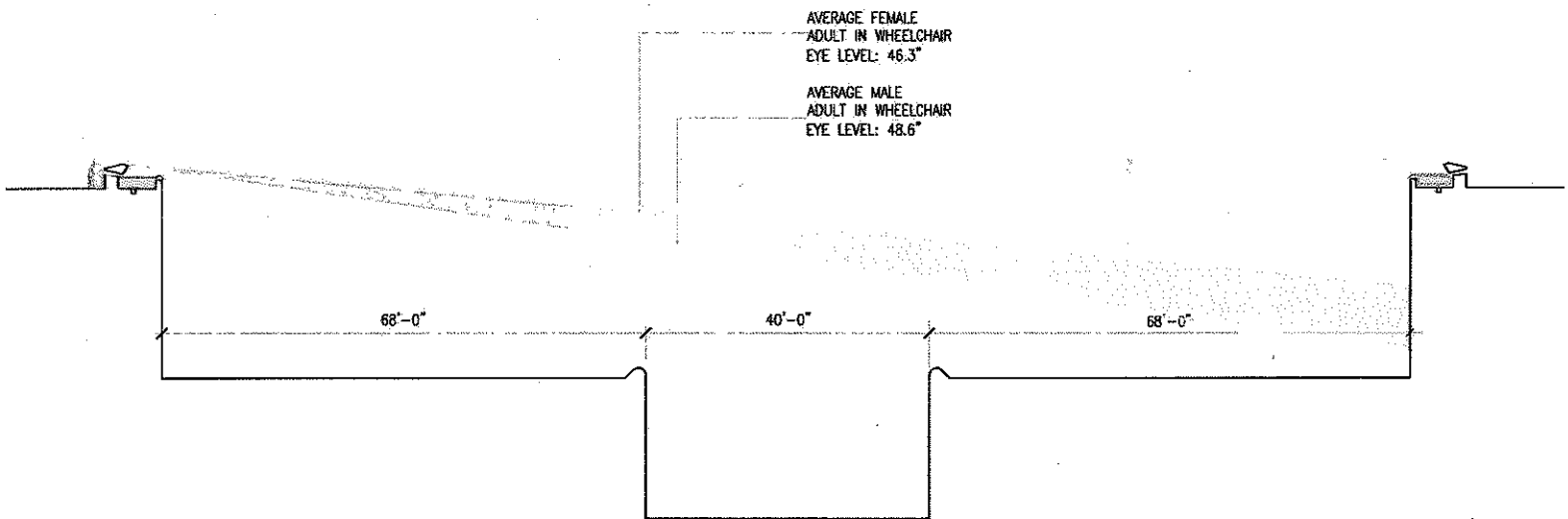
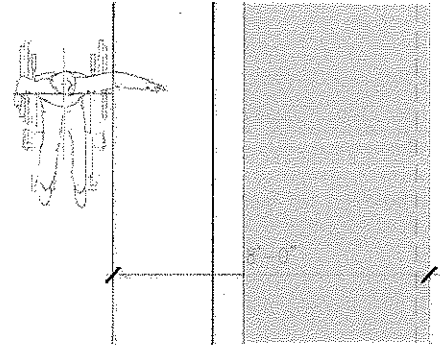
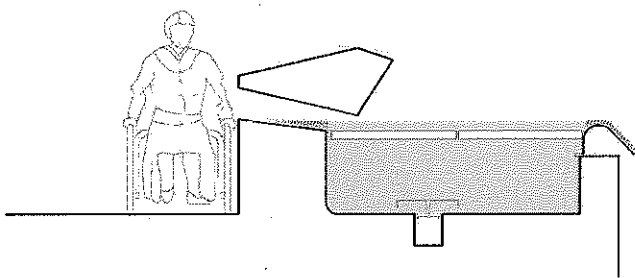
SIGHTLINES: STANDING AT SIDES



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SIGHTLINES: SEATED AT SIDES, FRONTAL



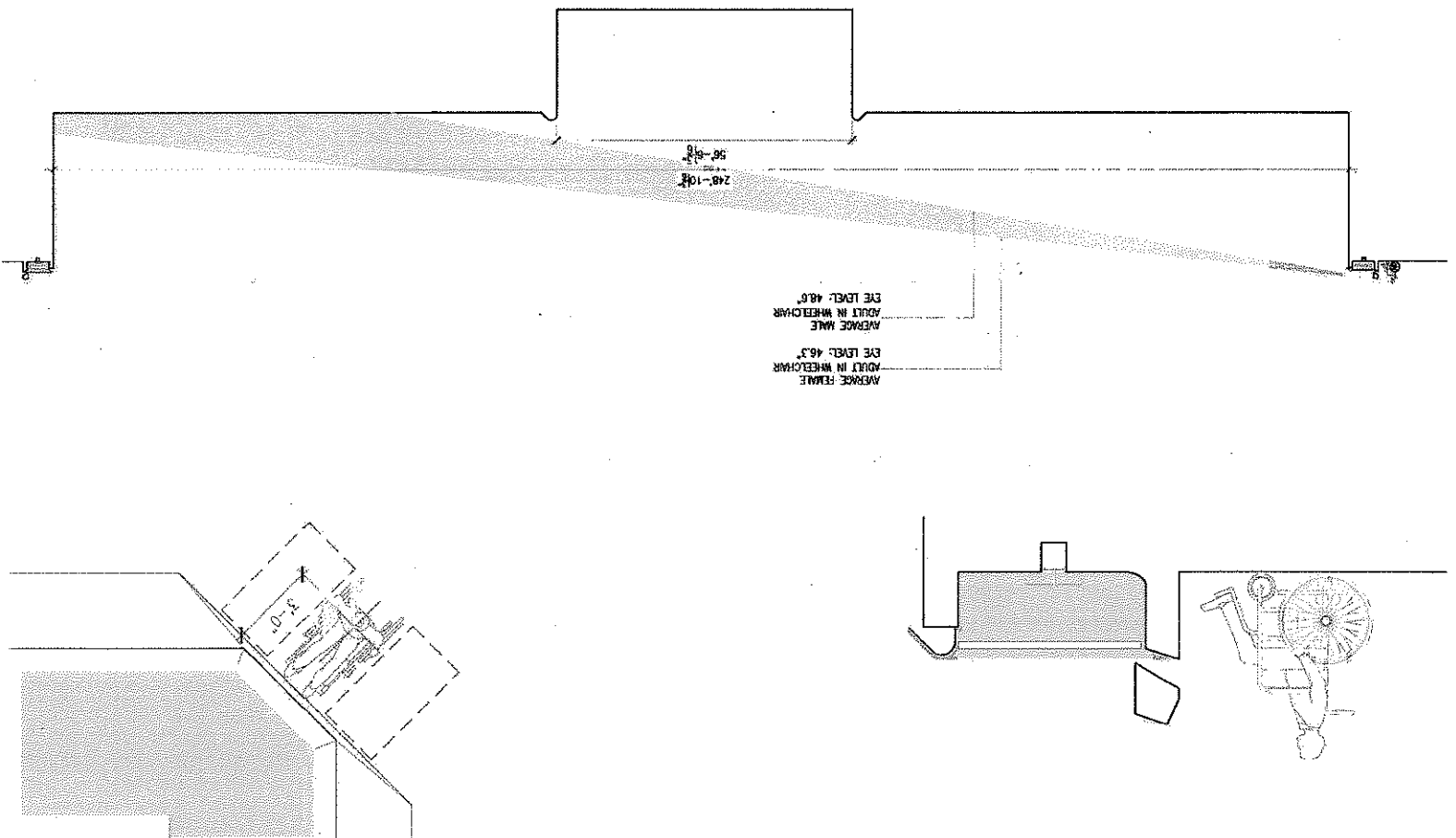
NATIONAL SEPTEMBER 11
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MARCH 27, 2009

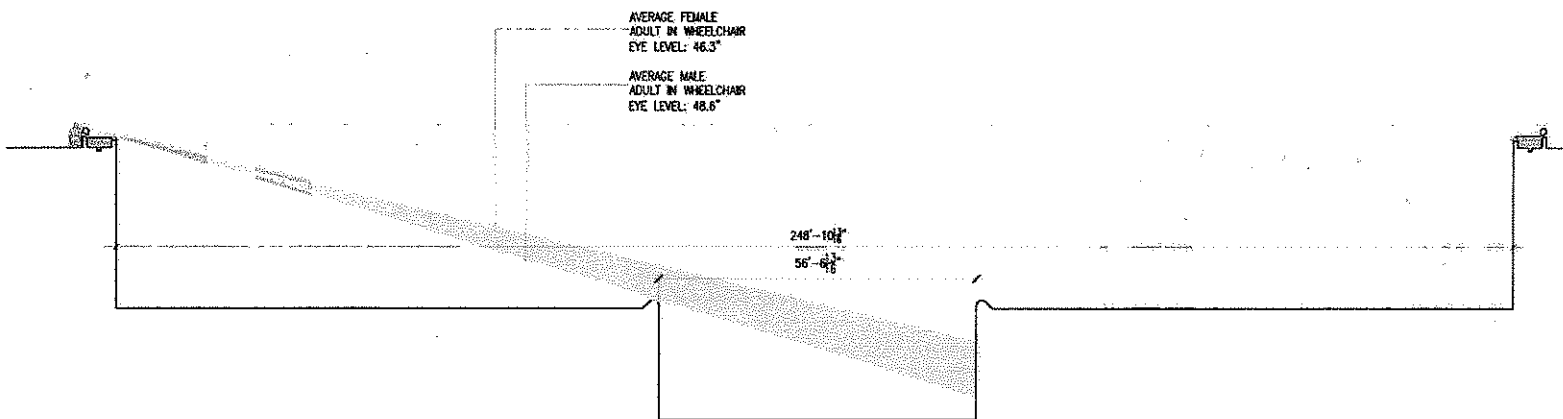
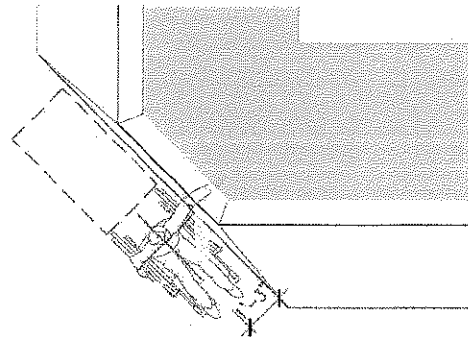
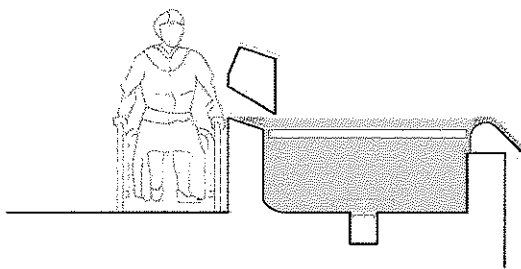
Davis Brody Bond Aedas
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ASK.032709.06

SIGHTLINES: SEATED AT SIDES, LATERAL

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 ASK.032709.07

SIGHTLINES: SEATED AT CORNER, FRONTAL

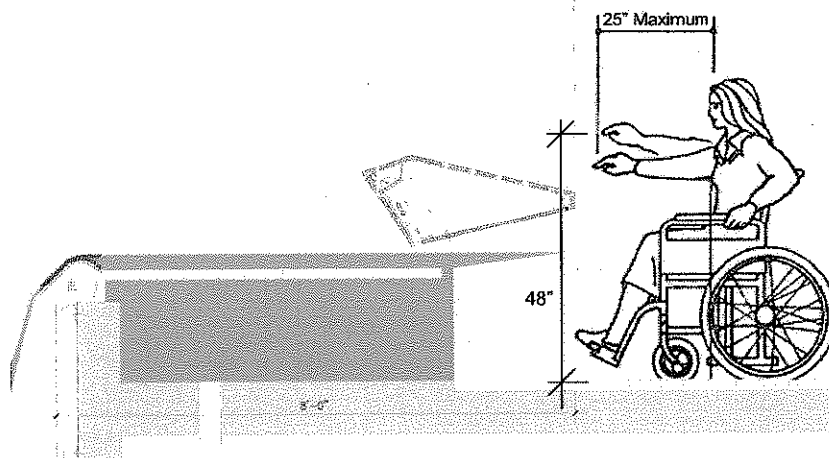




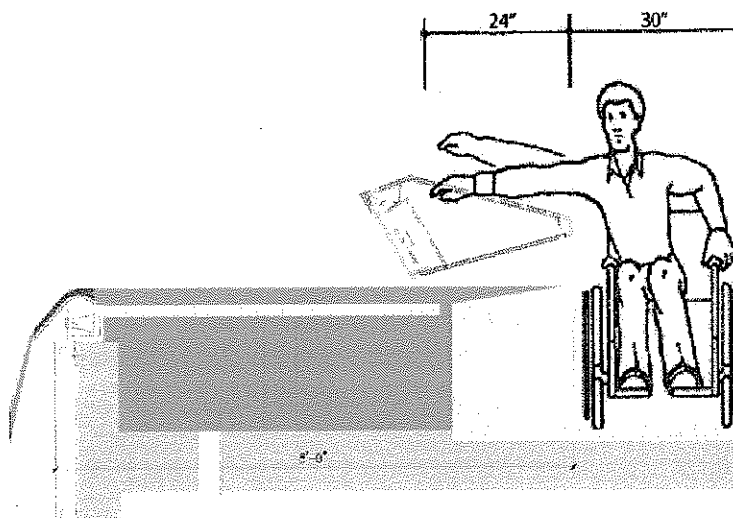
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MEMORIAL AND MUSEUM
MARCH 27, 2009

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SIGHTLINES: SEATED AT CORNER, LATERAL



NOTE: Source is ADA, Americans with Disabilities Act.



NOTE: Source is ADA, Americans with Disabilities Act.

NATIONAL SEPTEMBER 11
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REACH DIAGRAM: FRONTAL & LATERAL