STRUCTURAL CALCULATIONS
STOREFRONT GLASS

PROJECT:
Towne Storage Renovation
17 SE 3rd Avenue
Portland, Oregon 97214

for

Culver Glass
2619 NE Industrial Street
Portland, Oregon 97210

James G. Pierson, Inc.
STRUCTURAL ENGINEERS
Since 1945

STRUCTURAL REGISTERED PROFESSIONAL ENGINEER
18346PE
OREGON
March 19, 1996
PEDER R. GOLBERG
EXPIRES: 6-30-17

16-175526-DFS-01-CO

R. 97205

December 22, 2016

BREMIK CONSTRUCTION

SUBMITTAL PACKAGE FOR APPROVAL

Bremik Construction Inc.
16034- - Towne Storage Renovation - Phase II

DATE: 12.19.16
PACKAGE NUM: 28
PACKAGE REV: 0
SPEC #: 08

To: **Michael Roberts**
LRS Architects, Inc.
720 NW Davis, Suite 300
Portland, OR 97209

From:
Bremik Construction Inc.
1026 SE Stark St.
Portland, OR 97214

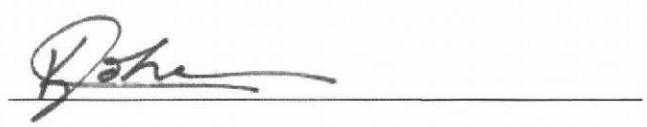
We are transmitting the following Submittal Package Number: "28", Revision: "0" Description: "NANAWALL" for your review, intended to be compliant with contract Specification Number: "08".

Please review and respond to: Kaleb Kohne , by: 12.23.16 in accordance with the contract documents.

Additional Notes:

Submittal Item	Revision	Description	Status	Notes
084329-01	0	Sliding Storefronts - Product Data	Submittal for Approval	
084329-02	0	Sliding Storefronts - Shop Drawings	Submittal for Approval	
084329-03	0	Sliding Storefronts - Manufacturer`s Installation	Submittal for Approval	

Sincerely,



Bremik Construction, Inc.
Date: 12.19.16 By: KK
☒ **Reviewed**
☐ **Reviewed as noted**
☐ **Revise & resubmit**

Review of these documents does not relieve subcontractors of their responsibility in reference to: field verifications of all dimensions; jobsite conditions and requirements; coordination with all trades; full compliance with all contract requirements; compliance with all state and city ordinance requirements

This submittal has been reviewed only for conformance with the design concept and for compliance with information given in the Contract Documents, and does not extend to means, methods, techniques, sequence of construction, dimensions, or safety precautions thereto. Review does not relieve the Contractor from responsibility for deviations from Drawings or Specifications unless the LRS Architect's attention has been called to such deviations in writing at the time of submission.

Corrections have been made on submittal material by LRS Architect's in accordance with Article 4.2.7 of the General Conditions of the Contract for Construction, with additional comments as follows:

No Exception Taken ☒ Make Corrections Noted ☐

Revise & Resubmit ☐ Record Only ☐

By: Zachary Freund

LRS ARCHITECTS

Date: 12/22/2016

Submittal No. 08 4329

Towne Storage Storefront Glass

GENERAL DESIGN LOADS:

Project is designed in accord with requirements of the 2014 Oregon Structural Specialty Code. For this location the following design parameters apply:

Wind: 120 MPH, EXP B (ASCE 7-10)

Design Summary:

The following calculations are for the proposed storefront glass at 17 SE 3rd Avenue in Portland, OR. The main portion of the work will be completed on the 6th floor of the existing Towne Storage building. The other portion of the work will be conducted inside the 1st floor.

For the mullion elevations A, B, C, F, G, I, and L it has been determined that a 3"x1/2"x6' steel plate must be inserted into the vertical members and secured at mid span. For the mullion elevations D, E, and H it has been determined that a 3"x1/2"x5' steel plate must be inserted into the vertical members and secured at mid span. This will need to occur for all mullions that are not considered "jambs" and will only need to occur at the 6th floor.

For connections at the 6th floor level it has been determined that #12-14 Dril-Flex screws in the proposed connection clip suffice for the top connection and #12-14x3" screws on each side of the mullion suffice for the bottom connection. For the connections on the 1st floor it has been determined that #12-14 Dril-Flex screws on each side of the mullion suffice for the top connection and ¼"x1-5/8" Kwik HUS-EZ concrete anchors suffice for the bottom connection.

The techniques and principles of structural analysis used for these calculations conform to generally accepted standards of the engineering community. These design calculations have been prepared based upon architectural drawings furnished by client.

SIMPLE-SPAN UNIFORMLY-LOADED MULLION ANALYSIS FOR WIND LOADING

Project: Towne Storage
Client: Culver Glass

Type	Part No.	Ix (in^4)	Sx (in^3)
A	TH-626	3.109	1.586
B	TH-687/688	3.489	1.804
C	None	0	0
D	None	0	0
E	None	0	0
F	None	0	0

Wind pressure per 2012 IBC Alternate All-Heights Method

Enter Basic Wind Speed		120 mph	Enter Importance Factor, I_w	1.00	Pressure, $q_z = 0.00256V^2$=	36.9 psf	
Enter Exposure		B	Enter K_{zt} per ASCE Fig. 6-4	1		Table 1609.6.2(1)	
Height Above Ground (not < 15ft)		56.0ft			K_z	0.837	(ASCE 7-10 Table 6-3)

	Window Frame	Span Length (in)	Left Lite (in)	Mullion Width (in)	Right Lite (in)	Trib. Width (in)	Mullion Effective Area (ft^2)	Pressure Zone	Negative Pressure Pnet (psf)	Positive Pressure Pnet (psf)	Negative Wind Load (#/in)	Mullion Type	$\Delta_{max\ (in)}$	Deflection Limit (in)	Deflection OK?	Req'd Steel Moment of Inertial (in^4)	f_b (psi)	Reinf. Required for Stress?	Comments, Additional Calculation, Etc.
	A	133	47 1/16	2 1/4	47 1/16	49 5/16	45.55	5	40.2	30.3	13.77	A	1.805	0.760	CHK 2403.3	1.474	19203psi	YES!	SEE ATTACHED ANALYSIS
	B	133	49 3/16	2 1/4	49 3/16	51 7/16	47.51	5	40.2	30.3	14.34	A	1.880	0.760	CHK 2403.3	1.580	19999psi	YES!	SEE ATTACHED ANALYSIS
	C	133	39 11/16	2 1/4	39 11/16	41 15/16	40.95	4	33.1	30.4	9.65	A	1.265	0.760	CHK 2403.3	0.712	13455psi	NO	SEE ATTACHED ANALYSIS
	D	133	40 3/4	2 1/4	40 3/4	43	40.95	4	33.1	30.4	9.90	B	1.156	0.760	CHK 2403.3	0.626	12129psi	NO	SEE ATTACHED ANALYSIS
	E	133	45 5/8	2 1/4	45 5/8	47 7/8	44.22	5	40.3	30.3	13.39	B	1.563	0.760	CHK 2403.3	1.271	16408psi	YES!	SEE ATTACHED ANALYSIS
	F	133	47 7/8	2 1/4	47 7/8	50 1/8	46.30	5	40.2	30.3	13.99	A	1.834	0.760	CHK 2403.3	1.515	19508psi	YES!	SEE ATTACHED ANALYSIS
						0	0.00		N/A	N/A	#VALUE!		#VALUE!	0.000	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
						0	0.00		N/A	N/A	#VALUE!		#VALUE!	0.000	#VALUE!	#VALUE!	#VALUE!	#VALUE!	

NOTES:
1. Wind pressures are calculated using the 2012 IBC Alternate All-Heights Method. Procedure described in Note 4 adjusts wind pressures to account for any discrepencies between the Alt. All-Heights Method and the .
2. Wind pressure for vertical member analysis is reduced using the effective wind area, as defined in ASCE 7 Chapter 6, for each condition.
3. Wind pressure for use in determining reactions was reduce based on the actual tributary area at reaction point.

SIMPLE-SPAN UNIFORMLY-LOADED MULLION ANALYSIS FOR WIND LOADING

Project: Towne Storage

Client: Culver Glass

Type	Part No.	Ix (in^4)	Sx (in^3)
A	TH-626	3.109	1.586
B	TH-687/688	3.489	1.804
C	None	0	0
D	None	0	0
E	None	0	0
F	None	0	0

Wind pressure per 2012 IBC Alternate All-Heights Method

Enter Basic Wind Speed		120 mph	Enter Importance Factor, I_w	1.00	Pressure, $q_z = 0.00256V^2$=	36.9 psf	
Enter Exposure		B	Enter K_{zt} per ASCE Fig. 6-4	1		Table 1609.6.2(1)	
Height Above Ground (not < 15ft)		56.0ft			K_z 0.837	(ASCE 7-10 Table 6-3)	

	Window Frame	Span Length (in)	Left Lite (in)	Mullion Width (in)	Right Lite (in)	Trib. Width (in)	Mullion Effective Area (ft^2)	Pressure Zone	Negative Pressure Pnet (psf)	Positive Pressure Pnet (psf)	Negative Wind Load (#/in)	Mullion Type	$\Delta_{max\ (in)}$	Deflection Limit (in)	Deflection OK?	Req'd Steel Moment of Inertial (in^4)	f_b (psi)	Reinf. Required for Stress?	Comments, Additional Calculation, Etc.
	G	133	47 1/16	2 1/4	47 1/16	49 5/16	45.55	5	40.2	30.3	13.77	A	1.805	0.760	CHK 2403.3	1.474	19203psi	YES!	SEE ATTACHED ANALYSIS
	H	133	47 7/16	2 1/4	47 7/16	49 11/16	45.89	4	33.1	30.3	11.41	B	1.332	0.760	CHK 2403.3	0.906	13981psi	NO	SEE ATTACHED ANALYSIS
	I	133	40 1/2	2 1/4	40 3/8	42 11/16	40.95	4	33.1	30.4	9.82	A	1.287	0.760	CHK 2403.3	0.744	13696psi	NO	SEE ATTACHED ANALYSIS
	J	133	29 5/16	2 1/4	0	16 29/32	40.95	4	33.1	30.4	3.89	A	0.510	0.760	OK	No Reinf.	5424psi	NO	
	K	133	29 5/16	2 1/4	0	16 29/32	40.95	4	33.1	30.4	3.89	A	0.510	0.760	OK	No Reinf.	5424psi	NO	
	L	133	45 3/16	2 1/4	45 3/16	47 7/16	43.81	5	40.3	30.3	13.27	A	1.739	0.760	CHK 2403.3	1.381	18498psi	YES!	SEE ATTACHED ANALYSIS
						0	0.00		N/A	N/A	#VALUE!		#VALUE!	0.000	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
						0	0.00		N/A	N/A	#VALUE!		#VALUE!	0.000	#VALUE!	#VALUE!	#VALUE!	#VALUE!	

NOTES:

1. Wind pressures are calculated using the 2012 IBC Alternate All-Heights Method. Procedure described in Note 4 adjusts wind pressures to account for any discrepencies between the Alt. All-Heights Method and the .
2. Wind pressure for vertical member analysis is reduced using the effective wind area, as defined in ASCE 7 Chapter 6, for each condition.
3. Wind pressure for use in determining reactions was reduce based on the actual tributary area at reaction point.

Project: Towne Storage
Client: Culver Glass

Type	Part No.	Ix (in⁴)	Sx (in³)
A	TH-626	3.109	1.586
B	None	0	0
C	None	0	0
D	None	0	0
E	None	0	0
F	None	0	0

Wind pressure per 2012 IBC Alternate All-Heights Method

Enter Basic Wind Speed		Enter Importance Factor, I_w	1.00	Pressure, $q_z = 0.00256V^2$=	0.0 psf
Enter Exposure		Enter K_{zt} per ASCE Fig. 6-4	1		Table 1609.6.2(1)
Height Above Ground (not < 15ft)				K_z N/A	(ASCE 7-10 Table 6-3)

	Window Frame	Span Length (in)	Left Lite (in)	Mullion Width (in)	Right Lite (in)	Trib. Width (in)	Mullion Effective Area (ft²)	Pressure Zone	Negative Pressure Pnet (psf)	Positive Pressure Pnet (psf)	Negative Wind Load (#/in)	Mullion Type	Δ_{max} (in)	Deflection Limit (in)	Deflection OK?	Req'd Steel Moment of Inertial (in⁴)	f_b (psi)	Reinf. Required for Stress?	Comments, Additional Calculation, Etc.
	M	156 1/4	33 5/8	2 1/4	36	37 1/16	56.51		5.0	5.0	1.29	A	0.321	0.893	OK	No Reinf.	2476psi	NO	
	N	156 1/4	41 3/8	2 1/4	36	40 15/16	56.51		5.0	5.0	1.42	A	0.355	0.893	OK	No Reinf.	2735psi	NO	
						0	0.00		N/A	N/A	#VALUE!		#VALUE!	0.000	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
						0	0.00		N/A	N/A	#VALUE!		#VALUE!	0.000	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
						0	0.00		N/A	N/A	#VALUE!		#VALUE!	0.000	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
						0	0.00		N/A	N/A	#VALUE!		#VALUE!	0.000	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
						0	0.00		N/A	N/A	#VALUE!		#VALUE!	0.000	#VALUE!	#VALUE!	#VALUE!	#VALUE!	
						0	0.00		N/A	N/A	#VALUE!		#VALUE!	0.000	#VALUE!	#VALUE!	#VALUE!	#VALUE!	

NOTES:
1. Wind pressures are calculated using the 2012 IBC Alternate All-Heights Method. Procedure described in Note 4 adjusts wind pressures to account for any discrepencies between the Alt. All-Heights Method and the .
2. Wind pressure for vertical member analysis is reduced using the effective wind area, as defined in ASCE 7 Chapter 6, for each condition.
3. Wind pressure for use in determining reactions was reduce based on the actual tributary area at reaction point.

Towne Storage

Cbeam 2005

Pierson

10/6/2016 15:05 File: Towne B.cbm

By: TDZ, EIT

Beam Results			
Max. Span Deflection	=	-1.0443"	(Span 2, @ 36.00")
Max. Positive Moment(1)	=	22509"#	(Span 1, @ 30.50")
Max. Positive Moment(2)	=	31840"#	(Span 2, @ 36.00")

Member Information

Span	L(in)	I(in^4)	S(in^3)	E(psi)	Reinf-I	Reinf-E
1	30.500	3.109	1.586	1.0e+007		
2	72.000	3.109	1.586	1.0e+007	1.125	2.9e+007
3	30.500	3.109	1.586	1.0e+007		

Distributed Load Information

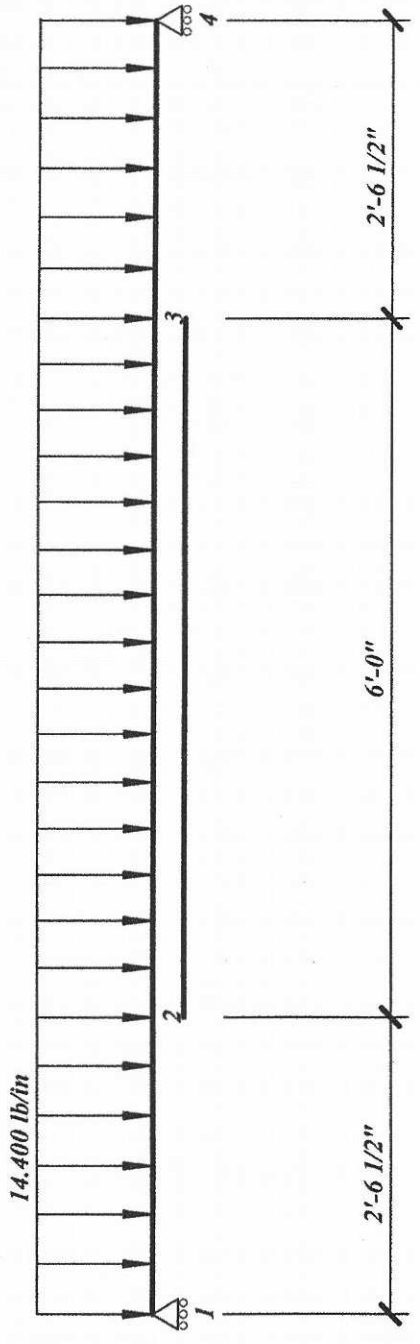
Span	W1(#/in)	W2(#/in)	X1(in)	X2(in)
1	14.400	14.400	0.000	30.500
2	14.400	14.400	0.000	72.000
3	14.400	14.400	0.000	30.500

Joints Free to Displace

Free Joints - 2 3

Support Reactions

Joint	Pounds
1	958
4	958



Maximum distributed load value shown only, see distributed load table for detailed information.

Towne Storage

Cbeam 2005

Pierson

10/6/2016 15:05 File: Towne B.cbm

Span No. 1

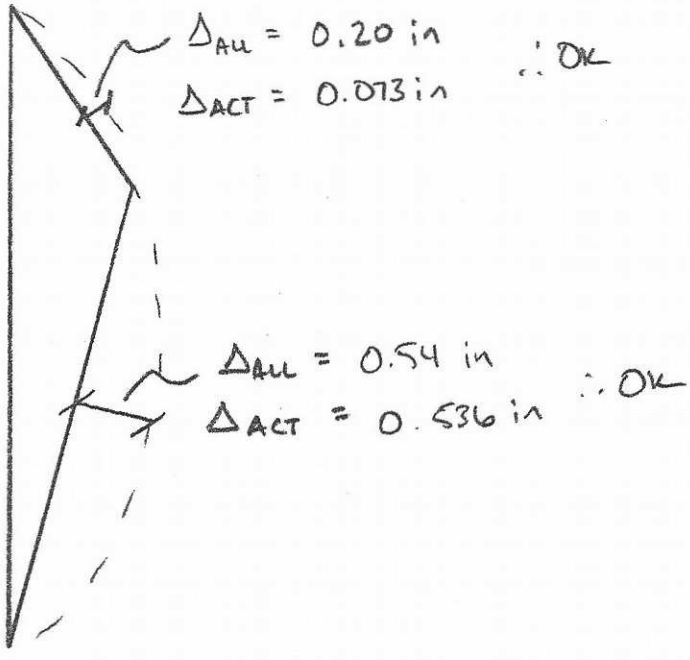
	0.00L	0.10L	0.20L	0.30L	0.40L	0.50L	0.60L	0.70L	0.80L	0.90L	1.00L
Location	0.00	3.05	6.10	9.15	12.20	15.25	18.30	21.35	24.40	27.45	30.50
Shear	957.60	913.68	869.76	825.84	781.92	738.00	694.08	650.16	606.24	562.32	518.40
Moment	-0.0	2853.7	5573.4	8159.2	10611.1	12928.9	15112.9	17162.8	19078.8	20860.9	22509.0
Defl.	0.0000	-0.0864	-0.1719	-0.2558	-0.3372	-0.4155	-0.4899	-0.5597	-0.6245	-0.6835	-0.7363
Stress	-0.0	1799.3	3514.2	5144.5	6690.5	8151.9	9528.9	10821.5	12029.5	13153.2	14192.3

Span No. 2

	0.00L	0.10L	0.20L	0.30L	0.40L	0.50L	0.60L	0.70L	0.80L	0.90L	1.00L
Location	0.00	7.20	14.40	21.60	28.80	36.00	43.20	50.40	57.60	64.80	72.00
Shear	518.40	414.72	311.04	207.36	103.68	0.00	-103.68	-207.36	-311.04	-414.72	-518.40
Moment	22509.0	25868.2	28481.0	30347.2	31467.0	31840.2	31467.0	30347.2	28481.0	25868.2	22509.0
Defl.	-0.7363	-0.8435	-0.9298	-0.9929	-1.0314	-1.0443	-1.0314	-0.9929	-0.9298	-0.8435	-0.7363
Stress	14192.3	16310.4	17957.7	19134.4	19840.4	20075.8	19840.4	19134.4	17957.7	16310.4	14192.3

Span No. 3

	0.00L	0.10L	0.20L	0.30L	0.40L	0.50L	0.60L	0.70L	0.80L	0.90L	1.00L
Location	0.00	3.05	6.10	9.15	12.20	15.25	18.30	21.35	24.40	27.45	30.50
Shear	-518.40	-562.32	-606.24	-650.16	-694.08	-738.00	-781.92	-825.84	-869.76	-913.68	-957.60
Moment	22509.0	20860.9	19078.8	17162.8	15112.9	12928.9	10611.1	8159.2	5573.4	2853.7	0.0
Defl.	-0.7363	-0.6835	-0.6245	-0.5597	-0.4899	-0.4155	-0.3372	-0.2558	-0.1719	-0.0864	0.0000
Stress	14192.3	13153.2	12029.5	10821.5	9528.9	8151.9	6690.5	5144.5	3514.2	1799.3	0.0



Towne Storage

Cbeam 2005

Pierson

11/17/2016 10:29 File: Towne E.cbm

By: TDZ, EIT

Beam Results			
Max. Span Deflection	=	-0.9675" (Span 2, @	30.00")
Max. Positive Moment(1)	=	23599"# (Span 3, @	0.00")
Max. Positive Moment(2)	=	29629"# (Span 2, @	30.00")

Member Information

Span	L(in)	I(in^4)	S(in^3)	E(psi)	Reinf-I	Reinf-E
1	36.500	3.489	1.804	1.0e+007		
2	60.000	3.489	1.804	1.0e+007	1.125	2.9e+007
3	36.500	3.489	1.804	1.0e+007		

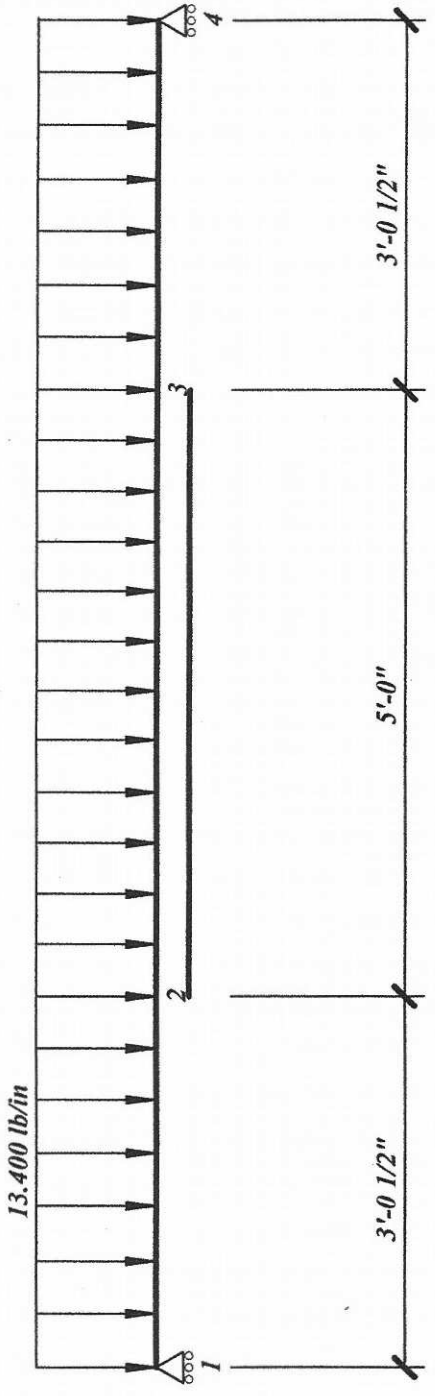
Distributed Load Information

Span	W1(#/in)	W2(#/in)	X1(in)	X2(in)
1	13.400	13.400	0.000	36.500
2	13.400	13.400	0.000	60.000
3	13.400	13.400	0.000	36.500

Joints Free to Displace
Free Joints - 2 3

Support Reactions

Joint	Pounds
1	891
4	891



Maximum distributed load value shown only, see distributed load table for detailed information.

Towne Storage

Cbeam 2005

Pierson

11/17/2016 10:29 File: Towne E.cbm

Span No. 1

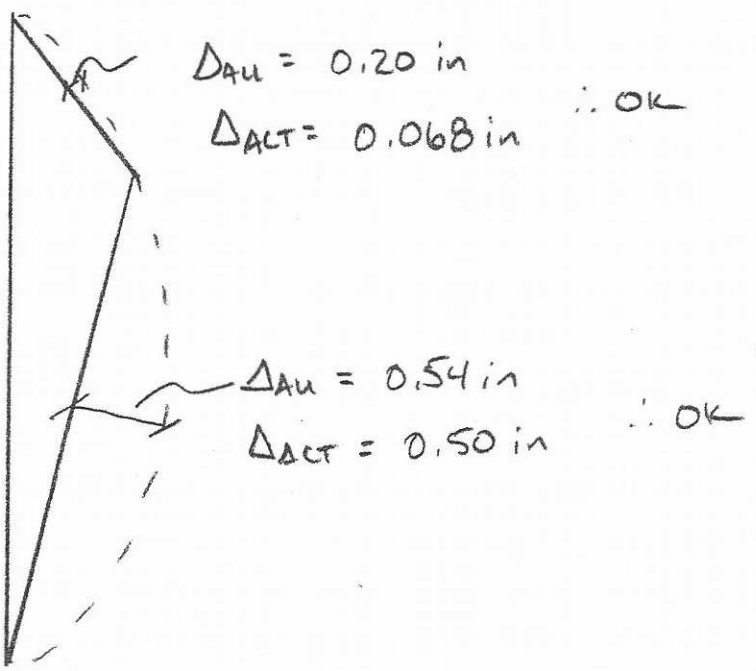
	0.00L	0.10L	0.20L	0.30L	0.40L	0.50L	0.60L	0.70L	0.80L	0.90L	1.00L
Location	0.00	3.65	7.30	10.95	14.60	18.25	21.90	25.55	29.20	32.85	36.50
Shear	891.10	842.19	793.28	744.37	695.46	646.55	597.64	548.73	499.82	450.91	402.00
Moment	0.0	3163.3	6148.0	8954.2	11581.9	14031.1	16301.7	18393.8	20307.4	22042.5	23599.1
Defl.	0.0000	-0.0953	-0.1895	-0.2812	-0.3696	-0.4536	-0.5322	-0.6045	-0.6699	-0.7275	-0.7767
Stress	0.0	1753.5	3408.0	4963.5	6420.1	7777.7	9036.4	10196.1	11256.9	12218.7	13081.5

Span No. 2

	0.00L	0.10L	0.20L	0.30L	0.40L	0.50L	0.60L	0.70L	0.80L	0.90L	1.00L
Location	0.00	6.00	12.00	18.00	24.00	30.00	36.00	42.00	48.00	54.00	60.00
Shear	402.00	321.60	241.20	160.80	80.40	0.00	-80.40	-160.80	-241.20	-321.60	-402.00
Moment	23599.1	25769.9	27458.3	28664.3	29387.9	29629.1	29387.9	28664.3	27458.3	25769.9	23599.1
Defl.	-0.7767	-0.8439	-0.8973	-0.9361	-0.9596	-0.9675	-0.9596	-0.9361	-0.8973	-0.8439	-0.7767
Stress	13081.5	14284.9	15220.8	15889.3	16290.4	16424.1	16290.4	15889.3	15220.8	14284.9	13081.5

Span No. 3

	0.00L	0.10L	0.20L	0.30L	0.40L	0.50L	0.60L	0.70L	0.80L	0.90L	1.00L
Location	0.00	3.65	7.30	10.95	14.60	18.25	21.90	25.55	29.20	32.85	36.50
Shear	-402.00	-450.91	-499.82	-548.73	-597.64	-646.55	-695.46	-744.37	-793.28	-842.19	-891.10
Moment	23599.1	22042.5	20307.4	18393.8	16301.7	14031.1	11581.9	8954.2	6148.0	3163.3	0.0
Defl.	-0.7767	-0.7275	-0.6699	-0.6045	-0.5322	-0.4536	-0.3696	-0.2812	-0.1895	-0.0953	0.0000
Stress	13081.5	12218.7	11256.9	10196.1	9036.4	7777.7	6420.1	4963.5	3408.0	1753.5	0.0



For questions on Cbeam, a Windows-based program, contact:

MCALSOFT LLC. www.mcalsoft.com

Ph (214) 217-2400 Fax (214) 217-2439

Email: software@mcalsoft.com

STRESS CHECK

F_b = 15100 psi

ELEVATIONS A, B, C, F, G, I, L

f_b @ ENDS = 14200 psi < 15100 psi ✓

$$f_b \text{ @ CENTER} = 20100 \times \left[\frac{3.109 \times 10 \times 10^6}{3.109 \times 10 \times 10^6 + 1.125 \times 29 \times 10^6} \right]$$

f_b = 9810 psi < 15100 psi ✓

∴ THIS MULLION WORKS W/ THIS REINFORCEMENT

ELEVATIONS D, E, H

f_b @ ENDS = 13100 psi < 15100 psi ✓

$$f_b \text{ @ CENTER} = 16425 \times \left[\frac{3.489 \times 10 \times 10^6}{3.489 \times 10 \times 10^6 + 1.125 \times 29 \times 10^6} \right]$$

f_b = 8500 psi < 15100 psi ✓

∴ THIS MULLION WORKS W/ THIS REINFORCEMENT.

* REINFORCEMENT 1/2" x 3" STEEL BAR ($I = 1.125\ in^4$)
SEE C-BEAM ANALYSIS FOR LENGTHS

REACTIONS / CONNECTIONS

WORST CASE (B)

TW = 51.5 in ℓ = 133 in

g^{-} = 40.2 psf

$\therefore$ W = 40.2 (51.5/12) = 173 lb/ft

$$R = \frac{173 \times 133}{2 \times 12} = 960 \text{ lb}$$

@ TOP CONNECTION (6) #12-14 SCREWS USED

$$V = \frac{960 \text{ lb}}{6} = 160 \text{ lb SHEAR PER SCREW}$$

PER ESR 3332, #12-14 TYPE 3/4 SCREWS HAVE 664 lb CAP., TYPE 5 SCREWS HAVE 834 lb CAP.

$\therefore$ #12-14 TYPE 3, 4, OR 5 SCREWS WORK @ TOP CONNECTION

THERE IS NO MOMENT IN THIS CASE, SO THERE IS NO TENSION OR WITHDRAWAL.

@ BOTTOM CONNECTION

$R = 960$ lb

$M = 960$ lb $\times$ 3/4 in $= 720$ in·lb

ASSUME (1) SCREW ON EACH SIDE

$\therefore V = 480$ lb EA.
$M = 360$ in·lb

$T = \frac{360}{1.5} = 240$ lb of WITHDRAWAL

IN DF BLOCKING, #12 SCREWS 154 lb/in

$\frac{240 \text{ lb}}{154 \text{ lb/in}} = 1.56$ in OF THREAD NEEDED

USING #12-14 DRIL-FLEX (SAME AS TOP)
CAP min = 664 lb IN SHEAR

$\therefore$ USE (1) #12-14 x 3 SCREW ON EACH SIDE OF INTERIOR MULLIONS; ONLY (1) NEEDED @ JAMBS

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Consulting Structural Engineers
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Tel: (503) 226-1286 Fax: (503) 226-3130

Project: Towne Storage	Job no.
Location: Portland, Oregon	Date: 12/22/2016
Client: Culver Glass	Sheet no.: Page 11 of 15

Project: **Towne Storage**
Client: **Culver Glass**
Condition: *Sill Fastening - Angle into Back of Frame, Tension Only*

Design for Screw Connections Based on 2005 Aluminum Specification

Input			Output			
Enter Screw Size:	12-24		**5.4.2 Screw Tensile Strength $P_{allow}=P_{nt}/(1.25n_s)$**			
Is screw countersunk?	Yes		P_{nt}=	**2966**	***lbs***	
Countersink Angle	0	Degrees	P_{allow}=	**791**	***lbs***	
Aluminum$_1$	***6061-T6 Sheet/Pate***		**5.4.2.1 Pull-Out Strength P_{not}**			
Aluminum$_2$	***6063-T6 Extrusions & Pipe***		K_s=	*1.2*		
C=	1		A_{sn}=	*0.461*	*in.^{2}/in.*	
D=	0.218	*in.*	P_{not}=	*666*	*lbs*	*Based on Eq. 5.4.2.1-1*
D_h=	0.184	*in.*	P_{allow}=	***222***	***lbs***	
D_w=	0.5	*in.*	**5.4.2.2 Pull-Over Strength P_{nov}**			
D_{ws}=	0.5	*in.*	P_{nov}=	4819	*lbs*	*Based on Eq. 5.4.2.2-2*
F_{tu1}=	42,000	*psi*	P_{allow}=	**1606**	***lbs***	
F_{tu2}=	30,000	*psi*	**5.4.3 Screw Shear and Bearing**			
F_{ty1}=	35,000	*psi*	The shear force on the screw shall not exceed the least of:			
F_{ty2}=	25,000	*psi*	*1) $2F_{tu1}\ D\ t_1/n_u$*			1,174 *(Eq. 5.4.3-1)*
F_{tus}=	120,000	*psi*	*2) $2F_{tu2}\ D\ t_2/n_u$*			684 *(Eq. 5.4.3-2)*
n=	24		*3) $[4.2(t_2^3\ D)^{1/2} F_{tu2}]/n_s$, for $t_2 <= t_1$*			638 *(Eq. 5.4.3-3)*
n_s=	3		*3) $P_{ns}/(1.25n_s)$*			422 *(Eq. 5.4.3-4)*
t_1=	0.125	*in.*				
t_2=	0.1019	*in.*				
t_c=	0.1019	*in.*				

Allowable Tension=	***222 lbs***
Allowable Shear/Bearing=	***422 lbs***

INTERIOR REACTIONS / CONNECTIONS

WORST CASE (N)

TW = 41 in ℓ = 156.25 in

q = 5 PSF

$\therefore W = 5 \times \frac{41}{12} = 17.1$ lb/ft

$R = \frac{17.1 \times 156.25}{2 \times 12} = 111$ lb

@ TOP CONNECTION USE (1) #12-14 TYPE 3 or 4 DRIL FLEX (V_{MAX} = 664 lb) ON EACH SIDE OF MULLION

@ BOTTOM CONNECTION USE (1) 1/4" x 1 5/8" KWIK-HUS EZ CONCRETE ANCHOR (V_{MAX} = 1315 lb) ON EA SIDE OF MULLION

FOLDING DOOR SYSTEM

WIND LOAD = 40 PSF →

WALL LOAD = 5 PSF ↓

$h = 11$ ft

ALL LOAD GOES TO TOP TRACK (CONSERVATIVE)

$W_H = (40 \text{ psf} \times 0.6) \times 11 \text{ ft} = 264 \text{ lb/ft}$

$W_V = 5 \text{ psf} \times 11 \text{ ft} = 55 \text{ lb/ft}$

∴ PER FOOT 264 lb of SHEAR AND 55 lb of TENSION

USING 18-8 SS BOLTS

$F_{nt} = 100$ ksi $\qquad F_{nv} = 60$ ksi

$$\frac{V}{V_a} + \frac{T}{T_a} < 1.0$$

$$V_a = 60 \frac{(1/4)^2 \times \pi/4}{2.0} = 1470 \text{ lb (ASD)}$$

$$T_a = 100 \frac{(1/4)^2 \pi/4}{2.0} = 2450 \text{ lb (ASD)}$$

@ 4' O.C.

$$\frac{(264 \times 4)}{1470} + \frac{(55 \times 4)}{2450} = 0.81 < 1.0 \checkmark$$

∴ USE 1/4" SS BOLTS @ 4' O.C.

(PLACE @ 2' O.C.)

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Client: Culver Glass		Sheet no.: Page 14 of 15

WHEN THE DOOR IS ALL OPEN, ALL LOAD WILL GO TO LAST BOLT, BUT NO WIND WILL BE INVOLVED

$P = 55\ lb/ft \times 32\ ft = 1760\ lb$

$1760 < 2450\ lb$ ∴ (1) 1/4" SS BOLT WORKS

@ BOTTOM; PINS COME OUT AND ENGAGE BOTTOM SILL WHICH IS ATTACHED TO A WOODEN BEAM

$W_H = \frac{264}{2} = 132\ lb/ft$

PER ESR 2236, SDS SCREWS ARE GOOD FOR

$250\ lb \times 1.33 = 330\ lb$

PANEL WIDTH ~ 4'

∴ $P = 132 \times 4 = 528\ lb$ @ EACH PIN

∴ USE (2) SDS SCREWS TO CONNECT BOTTOM TO BEAM @ EACH PIN LOCATION

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Project: Towne Storage	Job no.
Location: Portland, Oregon	Date: 12/22/2016
Client: Culver Glass	Sheet no.: Page 15 of 15

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ARCHITECTURAL COATINGS

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PERFORMANCE TEST REPORT

E03 TC670 SERIES
2 1/4" X 6" CAPTURED
VERTICAL OFFSET GLAZED SYSTEM
THERMALLY BROKEN
FOR 1" GLASS

PERFORMANCE TEST REPORT

ARCADIA, INC.
TC-670 CURTAIN WALL

CCLW JOB #04-4633

MARCH 31, 2005

DATE OF FORMAL TESTING

FEBRUARY 25 & 28, 2005

TESTED FOR

ARCADIA, INC.
3225 E. WASHINGTON BLVD.
LOS ANGELES, CALIFORNIA 90023

TEST LOCATION

CONSTRUCTION CONSULTING LABORATORY WEST
4751 WEST STATE STREET, SUITE B
ONTARIO, CA 91762

PH: 909-591-1789 **FAX: 909-627-9020**

MOCKUP DESCRIPTION

The mock-up specimen was one (1) two story, Arcadia TC-670 Standard Curtain Wall system with a 90° outside corner measuring 3' x 15' wide by 20' high.

For a complete description including sealant, anchorage, weeps, and framing details, see drawings at the conclusion of this report (sheets 1 through 18).

This report is not complete unless these drawings marked in red and stamped by this laboratory are included.

TEST LOADS Design loads (100%): **50.0 psf** Positive and **50.0 psf** Negative

All references to positive pressures are considered inward acting and negative is outward.

The mock up was tested in accordance with each applicable AAMA or ASTM standard.

TEST EQUIPMENT

The specimen was installed into a test chamber constructed of structural angles, beams, and columns covered with steel and plywood bulkheads, accessible through a bulkhead door.

Air infiltration was measured with a Meriam laminar flow element and a Dwyer electronic manometer.

Water was applied from a vertical spray rack mounted 24" from the specimen. The rack was equipped with swirl-type nozzles spaced two (2) feet on center, vertically and horizontally, which delivered five (5) gallons of water per hour per square foot of wall frontal area.

Pressure differentials were measured with a Dwyer electronic manometer.

The pressure differential between the exterior and interior of the chamber was created by a positive and negative blower system.

Structural deflections were measured with numerous dial indicator gages with follow-up hands.

Dynamic winds were generated by a Curtis Wright 3350 radial aireraft engine with a three (3) bladed propeller, 14'-5" diameter, which formulates typical and atypical wind conditions.

WITNESSED BY (all or partial)

Jack W. Jackson	Construction Consulting Laboratory West
Chad C. Jackson	Construction Consulting Laboratory West

PRE TEST

During the pre-testing the mock up was tested for:

Air infiltration and the gross leakage was found to be within the allowable leakage (20.3 cfm). Static water penetration at 10 psf found leakage at gasket corners and top of glass.

The mockup was deglazed and the intersections were resealed along with a heavier glazing gasket.

FORMAL TESTING AS FOLLOWS: **FEBRUARY 25 - 28, 2005**

Temperature at 8:15 AM was 57°F with relative humidity measured at 85%.

PRELOAD

To set the specimen for testing, a positive pressure differential of **25.0 psf** was applied to the specimen while exhausting air in the air infiltration test. It was held for ten (10) seconds and then reduced to **6.24 psf** to complete the air test.

ALLOWABLE

No visible signs of failure shall be allowed.

RESULTS

There was no indication of any failure.

AIR INFILTRATION TEST per ASTM E283-99

After the pre-test the laboratory conducted the air test. The exterior of the wall area was sealed with a visqueen material and tape. The exterior face of the specimen was then subjected to a positive static pressure differential of **6.24 psf**. Air infiltration was measured. This infiltration reading represents the amount of air infiltration through the chamber (tare). The visqueen was removed and a second reading recorded at **6.24 psf** pressure differential (gross) representing the amount of air infiltration through the wall area of the specimen and the chamber. Subtracting the former reading from the latter reading yields the amount of air infiltration through that portion of the tested specimen.

The gross air reading during the formal test was confirmed to be the same at 69 cfm total.

ALLOWABLE

Air infiltration shall not exceed **0.06 cfm** per square foot of fixed wall area as determined by actual measurement.

Net allowable based on measurements was **20.38 cfm** total.
(Area = 339.7 s/f x 0.06 cfm per s/f = **20.38 cfm** total allowed)

RESULTS

Specimen passed.

Air leakage measured a total of **15 cfm**. (39 – 24 = 15).

STATIC WATER PENETRATION TEST per ASTM E331-00

Water was applied to the exterior face of the specimen, at a minimum rate of five (5) gallons per hour per square foot of wall frontal area, in such a way as to completely cover the exterior face of the specimen. At the same time, a positive differential static pressure of **10.0 psf** was applied to the face of the specimen. The application of pressure and water was maintained for a period of fifteen (15) minutes, with observers viewing the interior of the specimen.

ALLOWABLE

Condensation is acceptable during water infiltration tests. Water leakage is acceptable only if all of the following conditions are satisfied: (a) water is contained and drained to exterior; (b) there is no wetting of a surface that would be visible to building occupants; (c) there would be no staining or other damage to completed building or its furnishings. Sources of water leakage shall be identified.

RESULTS

Specimen passed.

There was no water leakage noted.

DYNAMIC WATER PENETRATION TEST per AAMA 501.1-94

The specimen was subjected to a dynamic wind load pressure equivalent of **10.0 psf** (62.5 mph wind speed) with a water application of five (5) gallons per hour per square foot of wall frontal area for a duration of fifteen (15) minutes.

ALLOWABLE

There shall be no unacceptable water leakage same as the static water test above.

RESULTS

Specimen passed.

There was no water leakage noted.

UNIFORM STRUCTURAL DEFLECTION TEST @ DESIGN - ASTM E-330-97

The test specimen was subjected to a 50% positive design load of **25.0 psf**. The pressure was held for ten (10) seconds to set for positive testing and released. Indicators were set to zero.

The test specimen was subjected to a positive load of **50.0 psf**, 100% design load, held for ten (10) seconds and released. Indicators were read and all data was recorded.

The blower system, along with the measuring equipment, was then reversed. The test specimen was subjected to a negative 50% design load of **25.0 psf**. The pressure was held for ten (10) seconds to set for negative testing and released. Indicators were set to zero.

The test specimen was subjected to a negative load of **50.0 psf**, 100% design load, held for ten 10) seconds and released. Indicators were read and all data was recorded.

ALLOWABLE

No glass breakage, permanent damage to panels, fasteners or anchors shall occur. Perpendicular to the plane of the wall, net deflection of framing members shall not exceed **L/175** times span. Span is defined as the distance between anchor centerlines.

Parallel to the plane of the wall, deflection of corner mullion shall be limited to **1/4"** maximum at any time.

At connection points of framing members to anchors, combined movement of anchor relative to the building structure and framing member relative to each other, shall not exceed **1/16"** in any direction.

RESULTS

Specimen passed.

All measured spans complied with specified criteria. See drawings for dial indicator locations. See Charts **#1** and **#2** on page 8 for deflection and permanent set results (reference bold number - **xx**/xx for **deflection**). There was no glass breakage.

REPEAT STATIC WATER PENETRATION TEST per ASTM E331-00

Same procedure and allowable criteria as previous static water test.

RESULTS

Specimen passed.

There was no water leakage noted.

SEISMIC DISPLACEMENT - I – LATERAL

The intermediate floor framing of the mockup was made to move in a direction parallel to the main elevation. The framing was moved laterally one direction **3/4"**, returned to zero, then racked in the opposite direction **3/4"**, then returned to zero. This was repeated for a total of three (3) two-stroke cycles.

ALLOWABLE

Observations of behavior, flex at anchors and racking of framing will be recorded. There shall be no structural damage or failures including glass breakage or disengagement, gasket disengagement and sealant failure. System must remain watertight without repair.

RESULTS

Specimen passed.

There was no structural damage, no glass breakage or no disengagement, no sealant failure or gasket disengagement.

There was slight deflection of the mullion anchors, but no permanent deformation. After the movement the mockup returned to its original position.

REPEAT STATIC WATER PENETRATION TEST per ASTM E331-00

Same procedure and allowable criteria as previous static water test.

RESULTS

Specimen passed.

There was no water leakage noted

UNIFORM STRUCTURAL PROOF LOAD TEST per ASTM E330-97

The test specimen was subjected to a positive load of **37.5 psf** (75% design load).
The pressure was held for ten (10) seconds and released, with indicators then set to zero.

The test specimen was subjected to a positive load of **75.0 psf** (150% design load), held for ten (10) seconds and released. Indicators were read and all data recorded.

The blower system along with the measuring equipment was reversed. The test specimen was subjected to a negative load of **37.5 psf** (75% design load). The pressure was held for ten (10) seconds and released, with indicators set to zero.

The test specimen was subjected to a negative load of **75.0 psf** (150% design load), held for ten (10) seconds and released. Indicators were read and all data recorded.

ALLOWABLE

Net permanent deflection of framing members shall not exceed **L/1000** times span.
No permanent set in anchors of more than 1/16".

RESULTS

Specimen passed.

All measured spans complied with specified criteria. There was no glass breakage. See drawings for dial indicator locations. See Charts **#3** and **#4** on page 9 for deflection and permanent set results (reference bold number - xx/**xx** for **permanent set**).

SEISMIC DISPLACEMENT – II - LATERAL

The intermediate floor framing of the mockup was made to move in a direction parallel to the main elevation. The framing was moved laterally one direction **2"**, returned to zero, then racked in the opposite direction **2"**, then returned to zero. This was repeated for a total of three (3) two-stroke cycles.

ALLOWABLE

Yielding or breakage is allowed. Any detrimental effects after each displacement will be recorded.

No disengagement of any materials from the exterior wall (including trim and broken glass).

RESULTS

There was no structural damage, no glass breakage and no disengagement, no sealant failure and only minor gasket disengagement. There was slight deflection of the unit anchors, but no permanent deformation.

SEISMIC DISPLACEMENT – III - LATERAL

The intermediate floor framing of the mockup was made to move in a direction parallel to the main elevation. The framing was moved laterally one direction 3", returned to zero, then racked in the opposite direction 3", then returned to zero. This was repeated for a total of three (3) two-stroke cycles.

ALLOWABLE

Yielding or breakage is allowed. Any detrimental effects after each displacement will be recorded.

No disengagement of any materials from the exterior wall (including trim and broken glass).

RESULTS

There was no structural damage, no glass breakage and no disengagement, no sealant failure and only minor gasket disengagement. There was slight deflection of the unit anchors, but no permanent deformation.

END OF TESTING

As built mock-up drawings, reviewed and stamped by the laboratory, should accompany and are a part of this report.

Jack W. Jackson

CONSTRUCTION CONSULTING LABORATORY WEST
JACK W. JACKSON
PRESIDENT/MANAGER OF TESTING

Francis Pickell, Sr.

FRANCIS PICKELL, SR.
PROFESSIONAL ENGINEER

STRUCTURAL READINGS
100% DESIGN LOAD

ARCADIA – TC 670 SYSTEM
CCLW REPORT NO: 05-4633

CHART 1 OF 4
TEST PRESSURE = 50.0 PSF POSITIVE

DIAL IND.	MEMBER / D'TL	REF.	POSITION	GROSS READ	NET READ	ALLOW L/175	SPAN
1	VERT. MULL. – 2/12		BOTTOM	17/03	-	-	BASE
2	VERT. MULL. – 2/12	(1&3)	MID SPAN	59/03	49/02	70	122"
3	VERT. MULL. – 2/12		TOP	02/00	02/00	06	ANCH
4	HORIZ. MULL. – 1/ 6		MID SPAN	05/01	05/01	22	39.5"
5	GLASS – 1" INSULATED		CENTER	32/01	32/01	-	39.5"

CHART 2 OF 4
TEST PRESSURE = 50.0 PSF NEGATIVE

DIAL IND.	MEMBER / D'TL	REF.	POSITION	GROSS READ	NET READ	ALLOW L/175	SPAN
1	VERT. MULL. – 2/12		BOTTOM	14/02	-	-	BASE
2	VERT. MULL. – 2/12	(1&3)	MID SPAN	54/03	46/02	70	122"
3	VERT. MULL. – 2/12		TOP	02/00	02/00	06	ANCH
4	HORIZ. MULL. – 1/ 6		MID SPAN	04/01	04/01	22	39.5"
5	GLASS – 1" INSULATED		CENTER	35/01	35/01	-	39.5"

READINGS ARE IN HUNDRETHS OF INCH
READINGS ARE **DEFLECTION**/PERMANENT SET

DEFL. LIMIT = L/175
ANCHOR DEFL. = 1/16" (.06)
CORNER DEFL. = .25" MAX

STRUCTURAL READINGS
150% PROOF LOAD

ARCADIA – TC 670 SYSTEM
CCLW REPORT NO: 05-4633

CHART 3 OF 4
TEST PRESSURE = 75.0 PSF POSITIVE

DIAL IND.	MEMBER / D'TL	REF.	POSITION	GROSS READ	NET READ	ALLOW L/1000	SPAN
1	VERT. MULL. – 2/12		BOTTOM	20/04	-	-	BASE
2	VERT. MULL. – 2/12	(1&3)	MID SPAN	78/06	66/04	16	122"
3	VERT. MULL. – 2/12		TOP	03/00	03/00	06	ANCH
4	HORIZ. MULL. – 1/ 6		MID SPAN	06/01	06/01	04	39.5"
5	GLASS – 1" INSULATED		CENTER	43/01		-	39.5"

CHART 4 OF 4
TEST PRESSURE = 75.0 PSF NEGATIVE

DIAL IND.	MEMBER / D'TL	REF.	POSITION	GROSS READ	NET READ	ALLOW L/1000	SPAN
1	VERT. MULL. – 2/12		BOTTOM	20/02	-	-	BASE
2	VERT. MULL. – 2/12	(1&3)	MID SPAN	74/04	62/02	12	122"
3	VERT. MULL. – 2/12		TOP	04/01	04/01	06	ANCH
4	HORIZ. MULL. – 1/ 6		MID SPAN	06/01	06/01	04	39.5"
5	GLASS – 1" INSULATED		CENTER	45/01		-	39.5"

READINGS ARE IN HUNDRETHS OF INCH
READINGS ARE DEFLECTION/**PERMANENT SET**

PERM. SET LIMIT = L/1000
ANCHOR SET = 1/16" (.06)

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TC-670_MOCKUP	
DRAWN BY: SMN	DATE: 08/16/04
TESTED BY: ARCADIA	DATE: MAR 04 2005
SHEET 1	OF 18

MOCK UP GENERAL RULES

M/U TEST PROCEDURE - DESIGN PRESSURE OF ;50 PSF.

ORDER OF PROCEDURE:

1. PRELIMINARY LOADING - PRE-LOAD TO 50% MAXIMUM POSITIVE DESIGN PRESSURE (25 PSF).
2. STATIC PRESSURE AIR INFILTRATION - (ASTM E283) TEST PRESSURE OF 6.24 PSF WITH LOSS NOT TO EXCEED .06 CFM PER SQUARE FOOT OF WALL SURFACE.
3. STATIC PRESSURE WATER INFILTRATION - (ASTM E331) TEST PRESSURE OF 10 PSF WITH WATER APPLIED AT A MINIMUM RATE OF FIVE GALLONS PER HOUR PER SQUARE FEET FOR 15 MINUTES WITH NO UNCONTROLLED WATER.
4. DYNAMIC PRESSURE WATER INFILTRATION - (AAMA 501.1) TEST PRESSURE OF 10 PSF WITH WATER APPLIED AT A MINIMUM RATE OF FIVE GALLONS PER HOUR PER SQUARE FEET FOR 15 MINUTES WITH NO UNCONTROLLED WATER.
5. STRUCTURAL LOADING - (ASTM E330) EACH PRESSURE HELD FOR TEN SECONDS AS FOLLOWS
   50% POSITIVE DESIGN - 25 PSF
   100% POSITIVE DESIGN - 50 PSF
   50% NEGATIVE DESIGN - 25 PSF
   100% NEGATIVE DESIGN - 50 PSF
   RECORD DEFLECTIONS AT ALL PRESSURES.
6. REPEAT STATIC WATER PRESSURE INFILTRATION.
7. SEISMIC LATERAL TEST (PARALLEL TO PLANE OF WALL)

   A. FIRST DISPLACEMENT CYCLE:
   DISPLACE THE MID SUPPORTING STRUCTURE 3/4" TO THE LEFT AND RETURN TO THE STARTING LOCATION OF 0".
   DISPLACE THE MID SUPPORTING STRUCTURE 3/4" TO THE RIGHT AND RETURN TO THE STARTING LOCATION OF 0".

   B. FIRST REPLACEMENT CYCLE SHALL BE REPEATED THREE TIMES. VISUALLY INSPECT THE WALL AT EACH DISPLACEMENT. NO FAILURE OR DETERIORATION ALLOWED.
8. REPEAT STATIC WATER TEST AS DEFINED IN TEST #2.
9. SAFETY FACTOR LOADING - (ASTM E330) EACH PRESSURE HELD FOR TEN SECONDS AS FOLLOWS:
   150% POSITIVE DESIGN - 75 PSF
   150% NEGATIVE DESIGN - 75 PSF
10. SIESMIC LATERAL TEST (PARALLEL TO PLANE OF WALL)

    A. SECOND DISPLACEMENT CYCLE SAME AS 7A EXCEPT USE 1 1/2".

    B. SECOND DISPLACEMENT CYCLE SHALL BE REPEATED THREE TIMES. VISUALLY INSPECT THE WALL AT EACH DISPLACEMENT. GLASS MAY SHIFT, WEDGE GASKETS MAY DIS-ENGAGE AND SEALANTS MAY SPLIT OR LOOSE ADHESION. PERMANENT MIS-ALIGNMENT OF CLADDING & FRAMES SHALL BE ISOLATED AND MINOR. PERMANENT DEFORMATION OF METAL COMPONENTS WILL BE ACCEPTABLE. CURTAIN WALL COMPONENTS SHALL NOT DIS-ENGAGE FROM STRUCTURE.

CONSTRUCTION CONSULTING LABORATORY, WEST
REPORT NO. #05-4633
DATE: March 31, 2005
PAGE: 1 OF 18

SEISMIC RACKING '97 UBC TEST SEQUENCE:

THE INTERMEDIATE FRAME SUPPORTING THE SPECIMEN WAS DISPLACED LATERALLY TO THE LEFT 2 INCHES, HELD FOR A MINIMUM OF TEN (10) SECONDS, RETURNED TO ZERO, AND THEN DISPLACED TO THE RIGHT 2 INCHES, HELD FOR A MINIMUM OF TEN (10) SECONDS, RETURNED TO ZERO.

THE INTERMEDIATE FRAME SUPPORTING THE SPECIMEN WAS DISPLACED LATERALLY TO THE LEFT 3 INCHES, HELD FOR A MINIMUM OF TEN (10) SECONDS, RETURNED TO ZERO, AND THEN DISPLACED TO THE RIGHT 3 INCHES, HELD FOR A MINIMUM OF TEN (10) SECONDS, RETURNED TO ZERO.

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TC-670_MOCKUP	
DRAWN BY: SMN	DATE: 08/16/04
TESTED BY: ARCADIA	DATE: MAR 0 4 2005

SHEET 2 OF 18

CONSTRUCTION CONSULTING LABORATORY, WEST

REPORT NO. #05-4633

DATE: MARCH 31, 2005

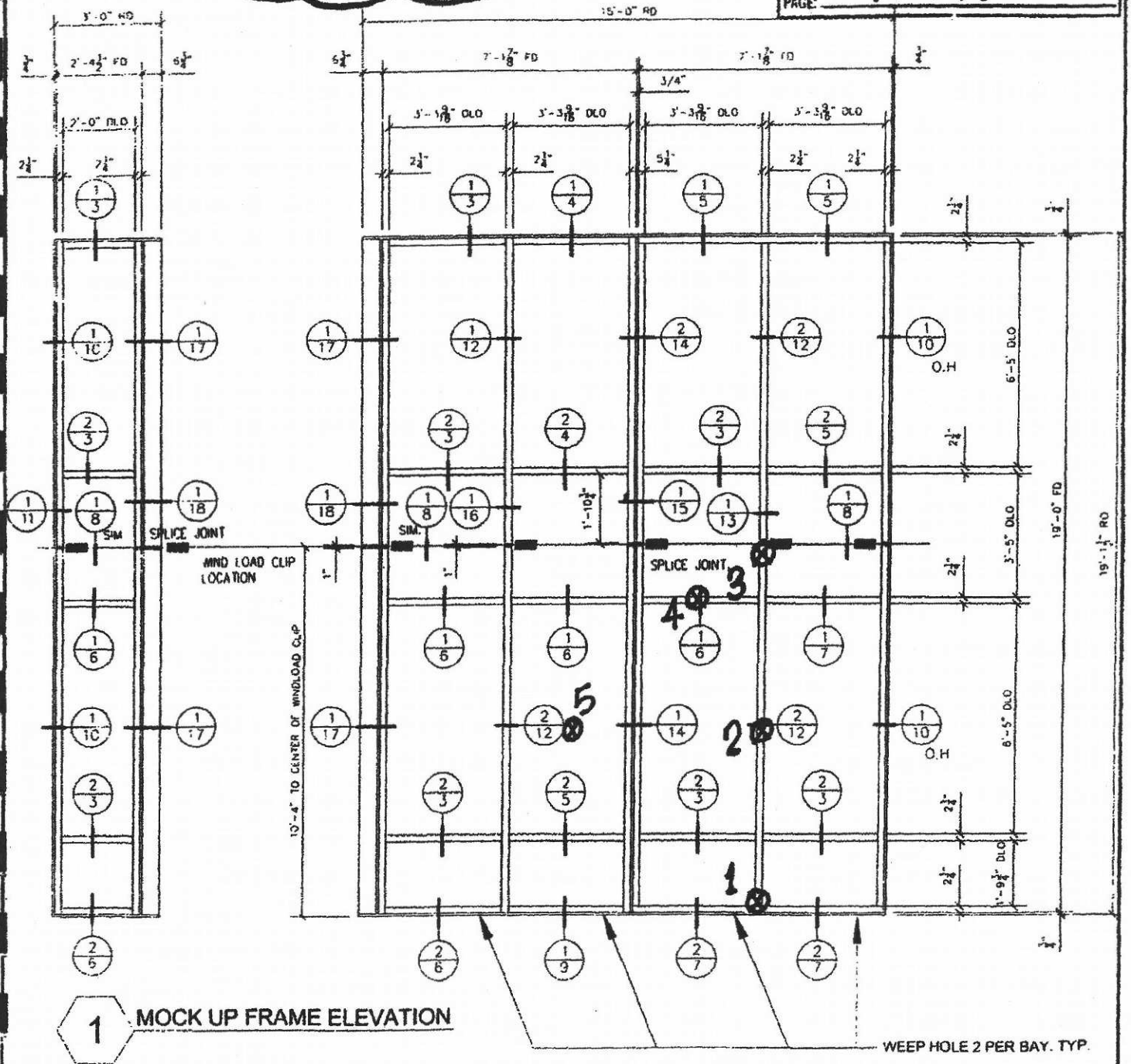
PAGE: 2 OF 18

LEGEND

1" GLASS

1/4" GLASS

⊗ - DENOTES LOCATION OF DIAL INDICATORS DURING STRUCTURAL TESTING



1 MOCK UP FRAME ELEVATION

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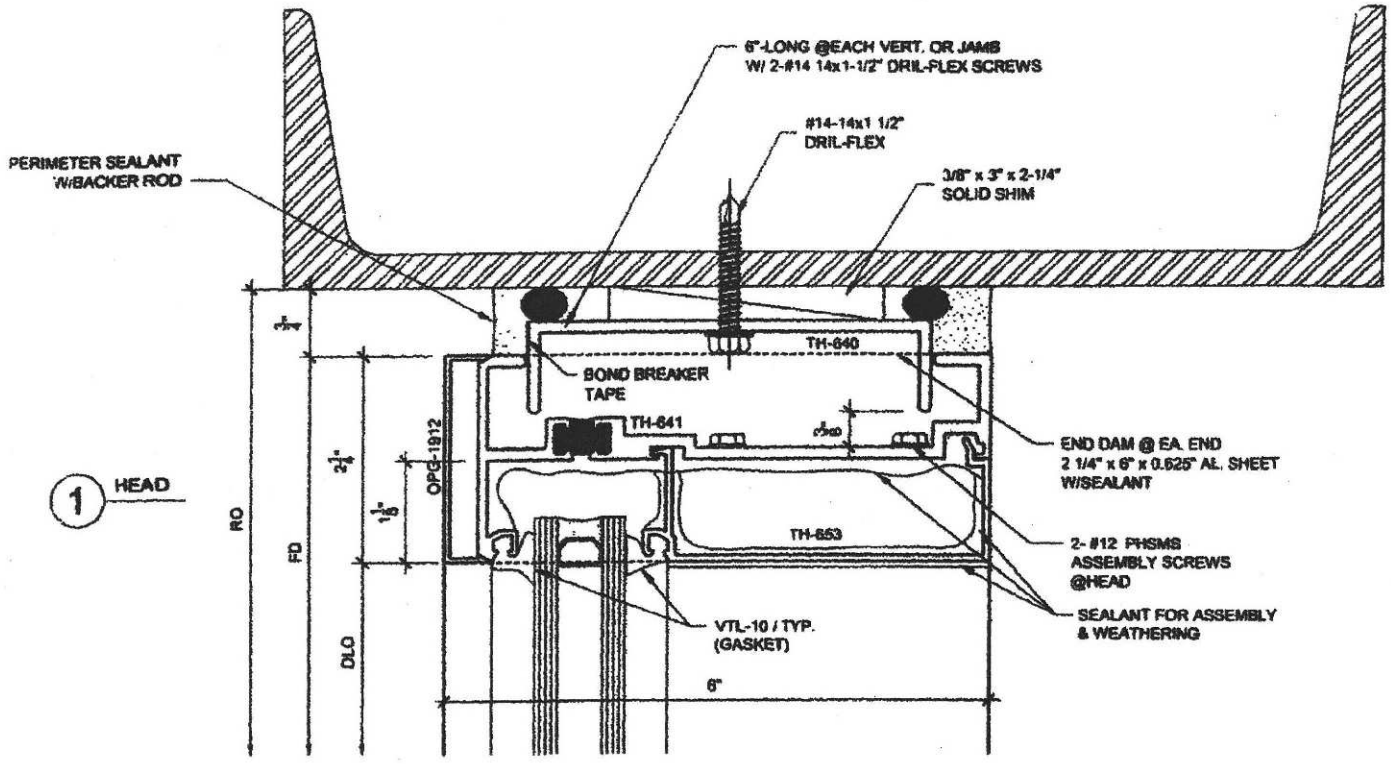

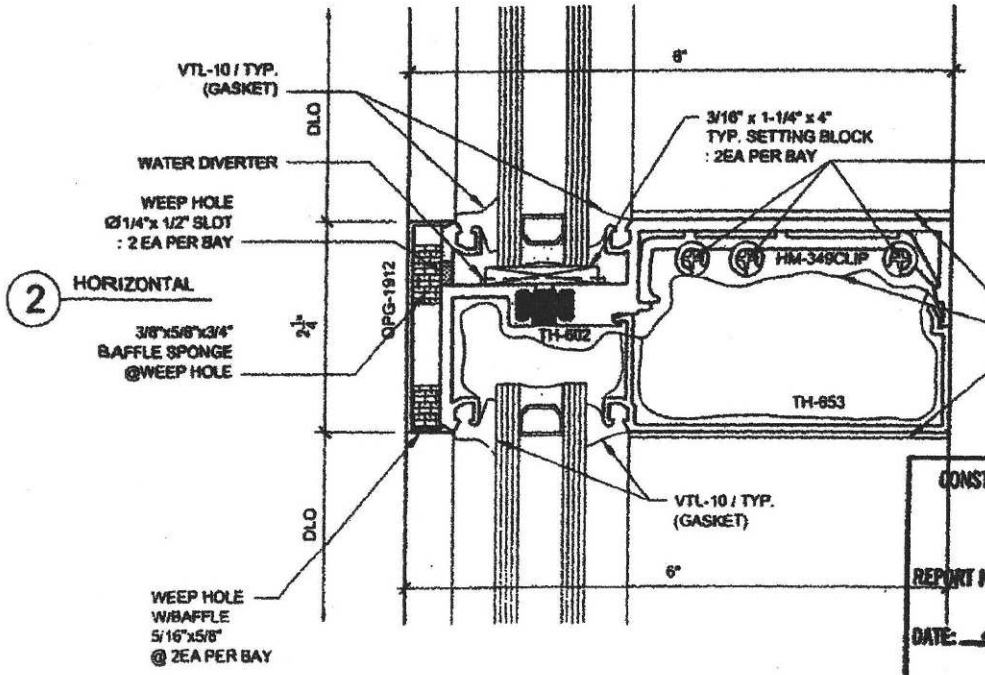

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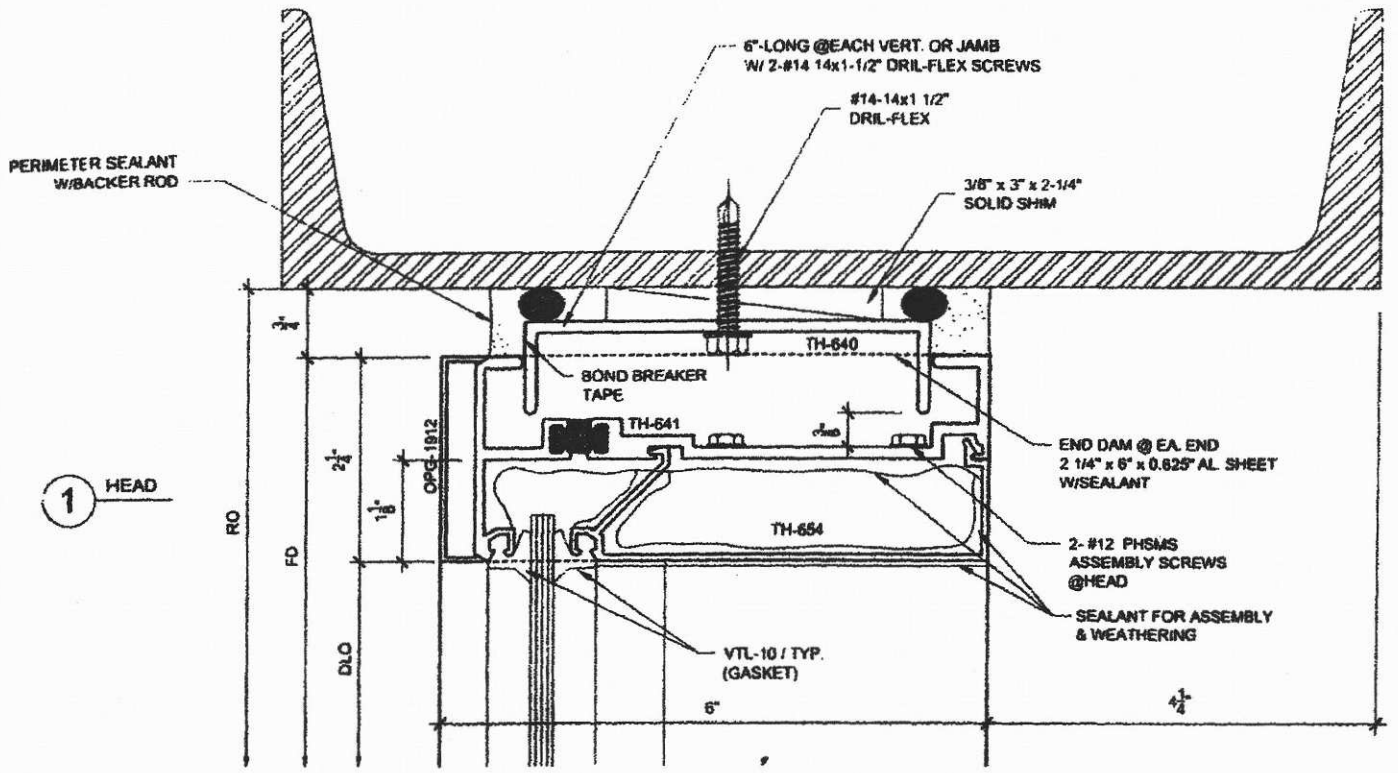

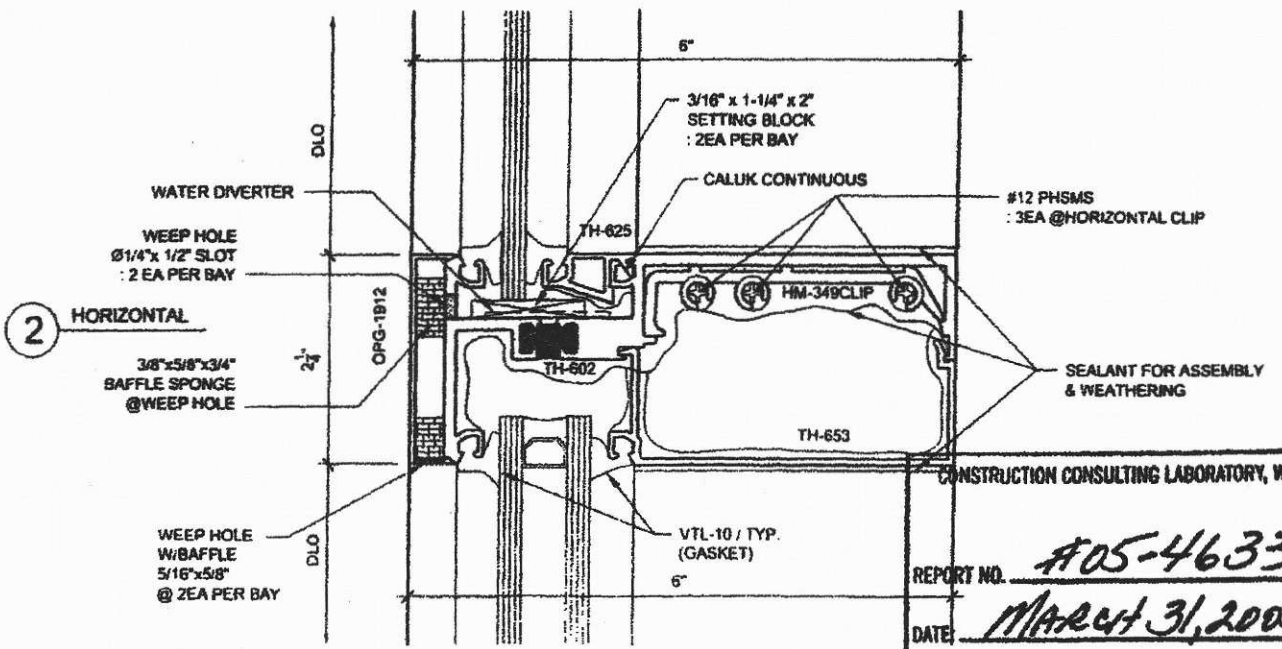

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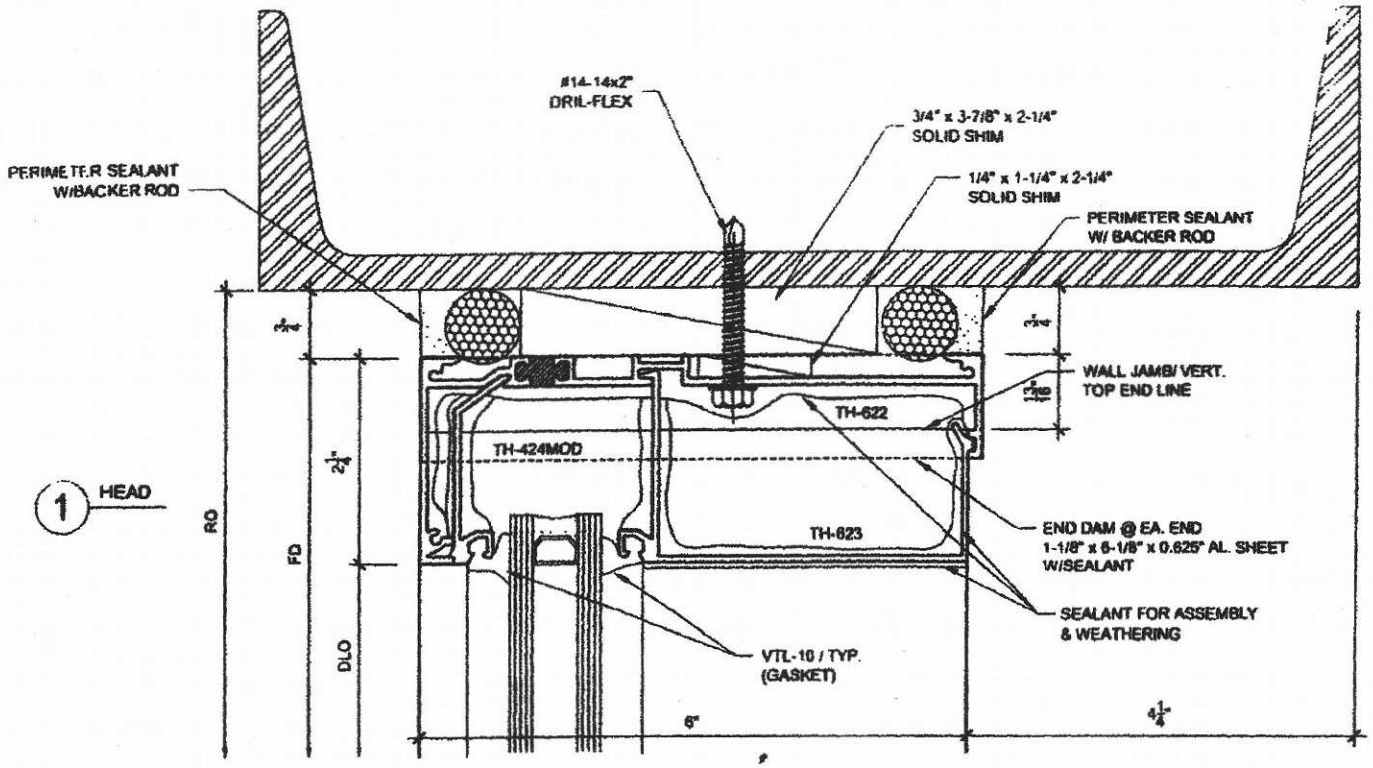

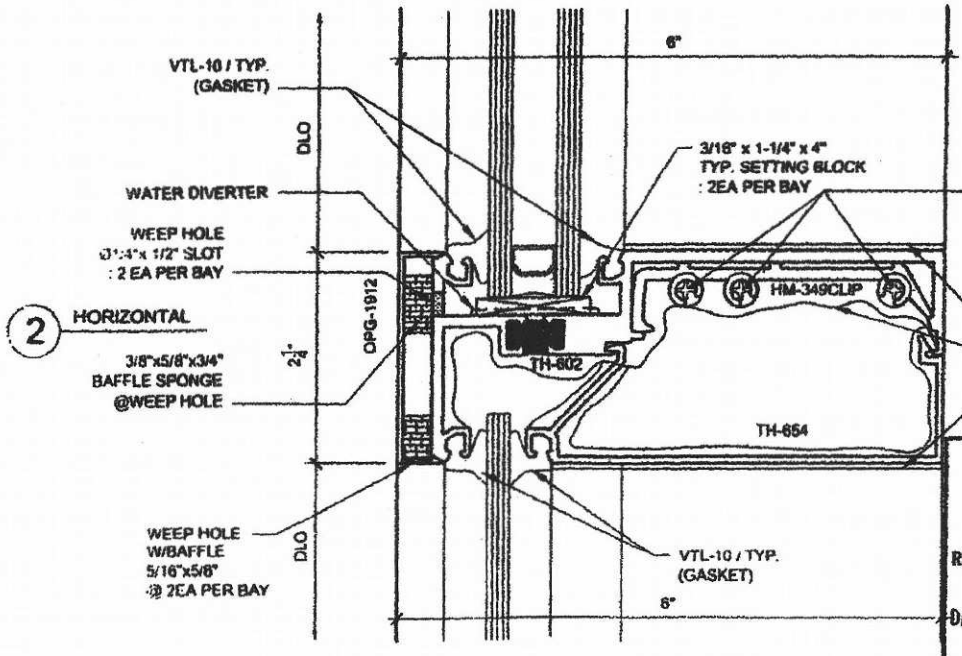

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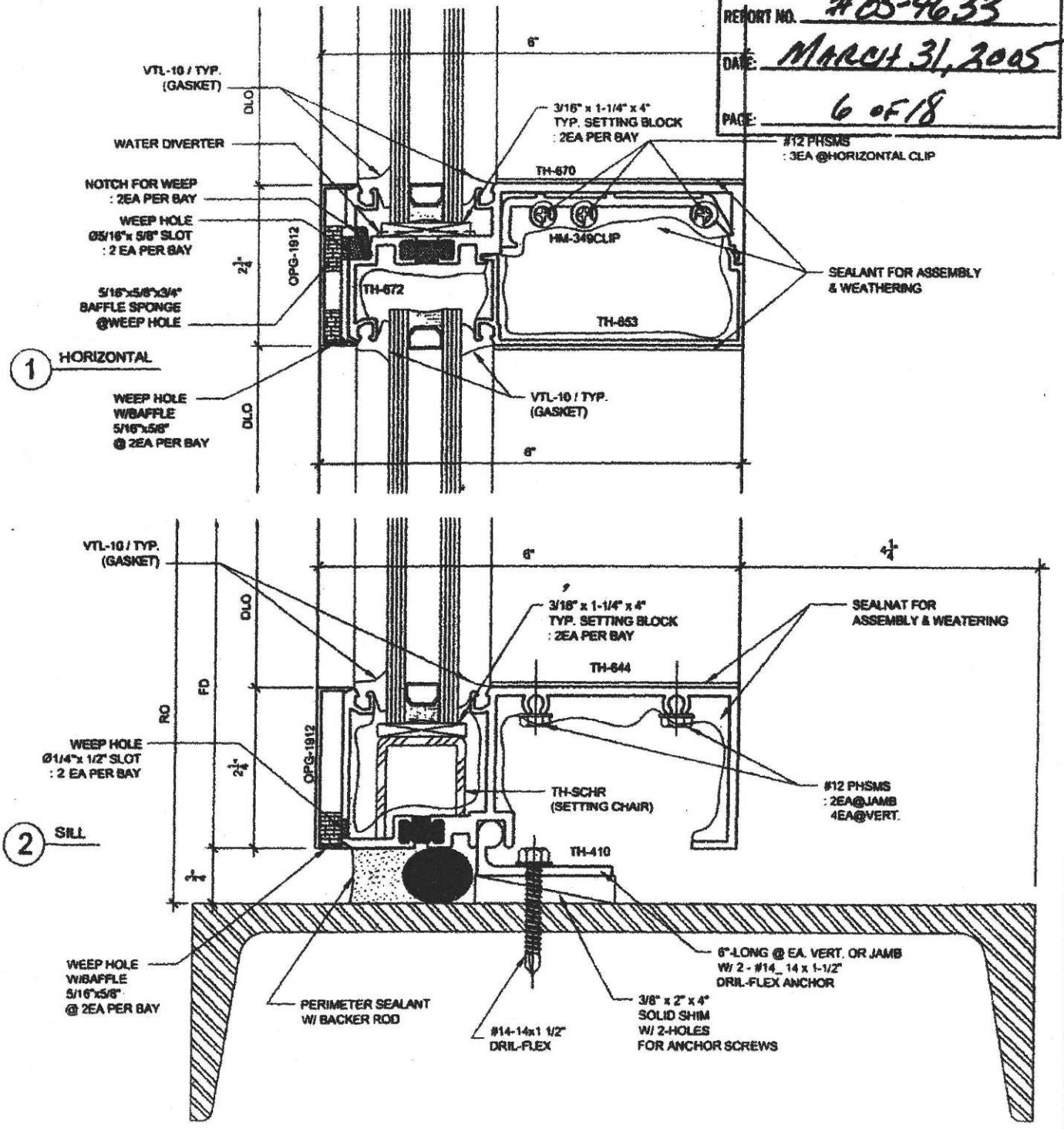

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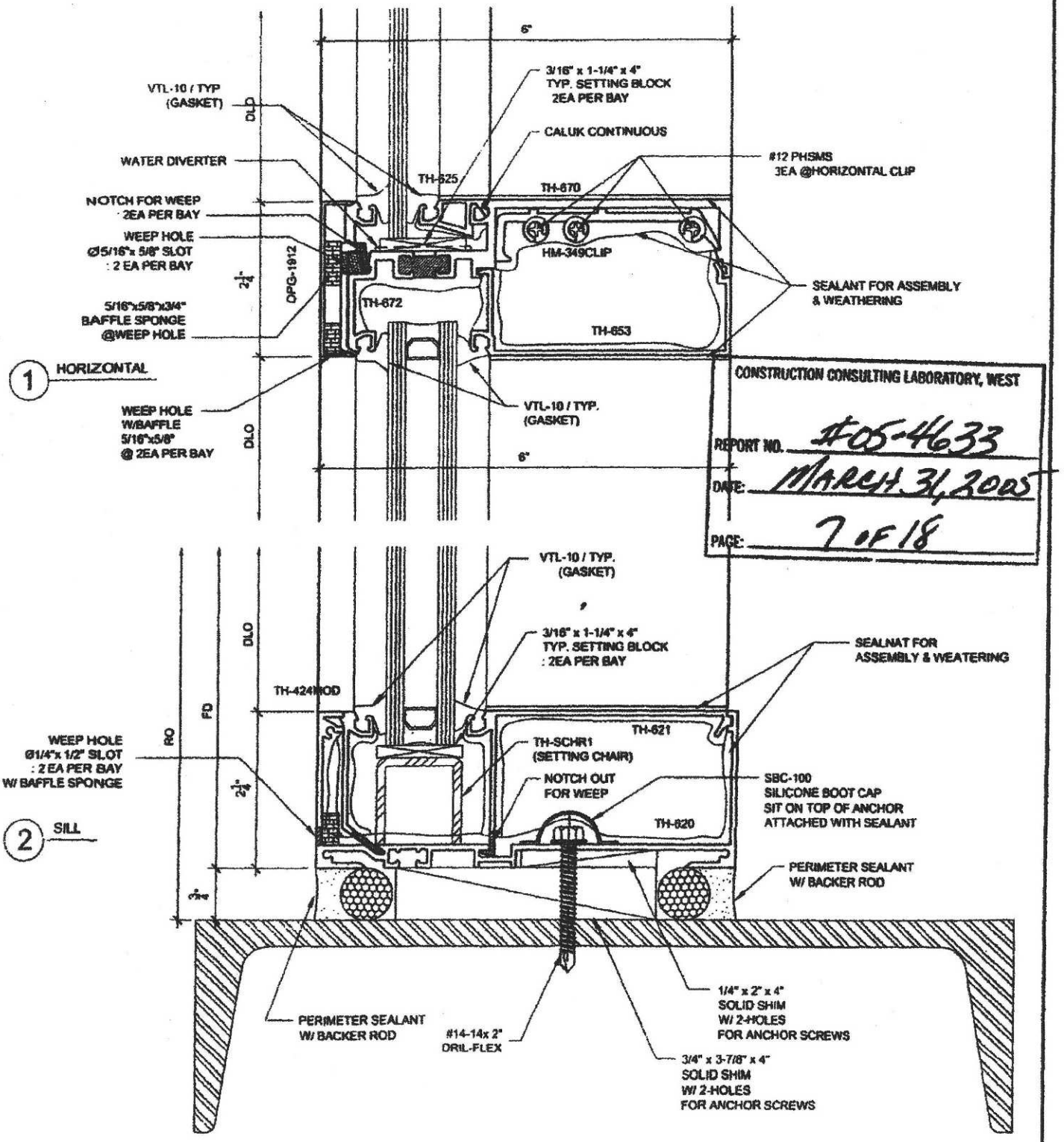

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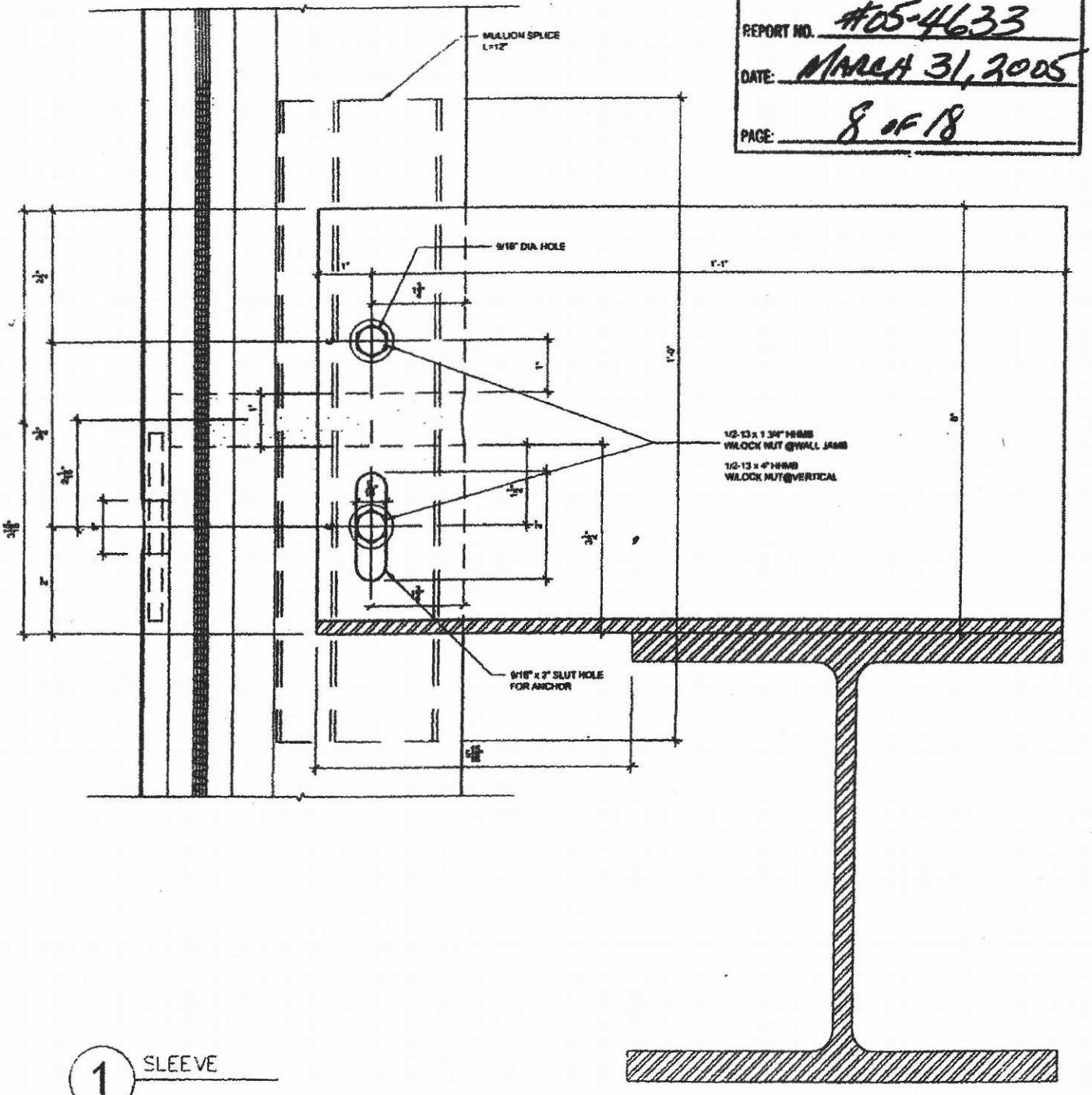

1 SLEEVE

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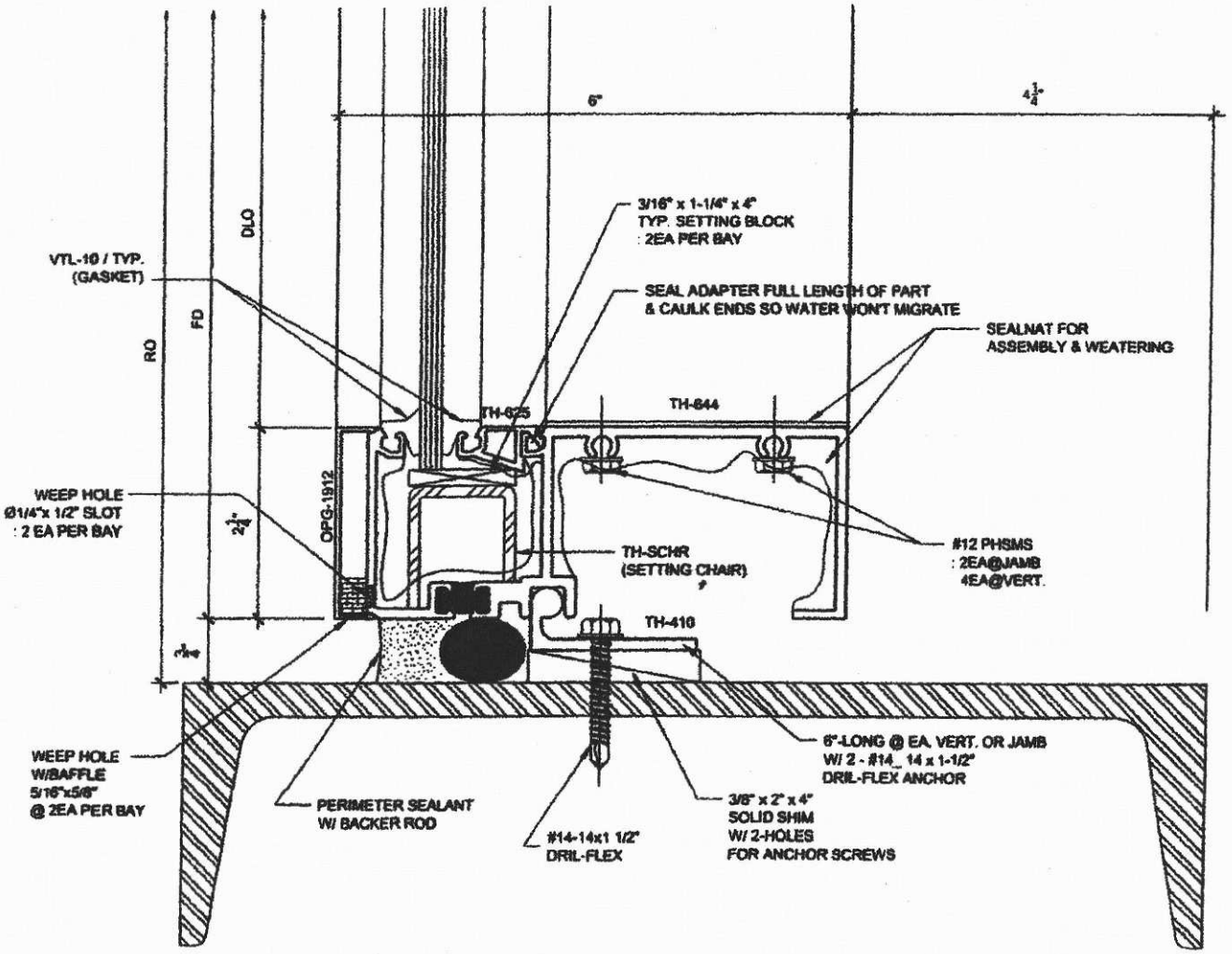

1 SILL

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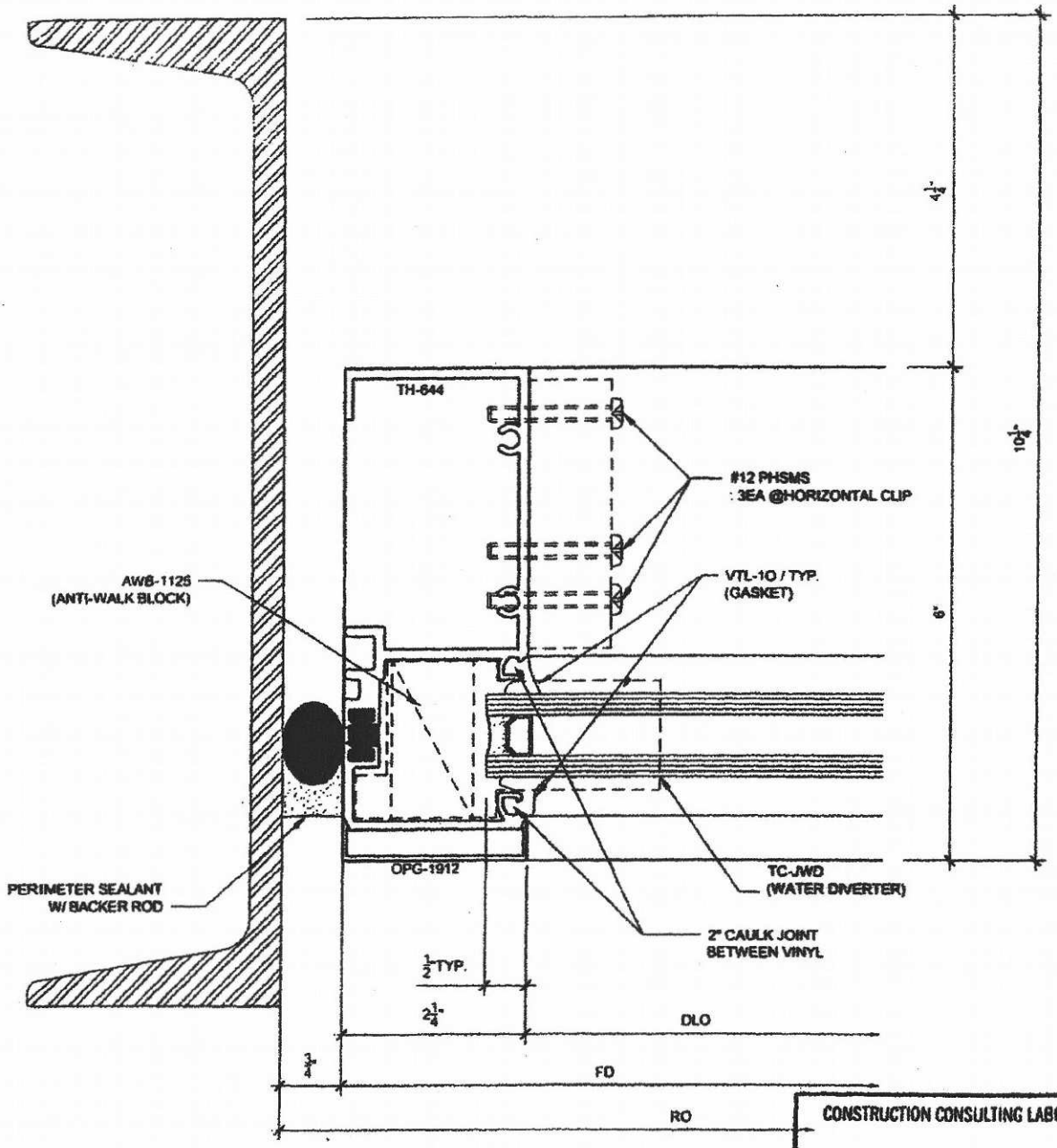

1 WALL JAMB

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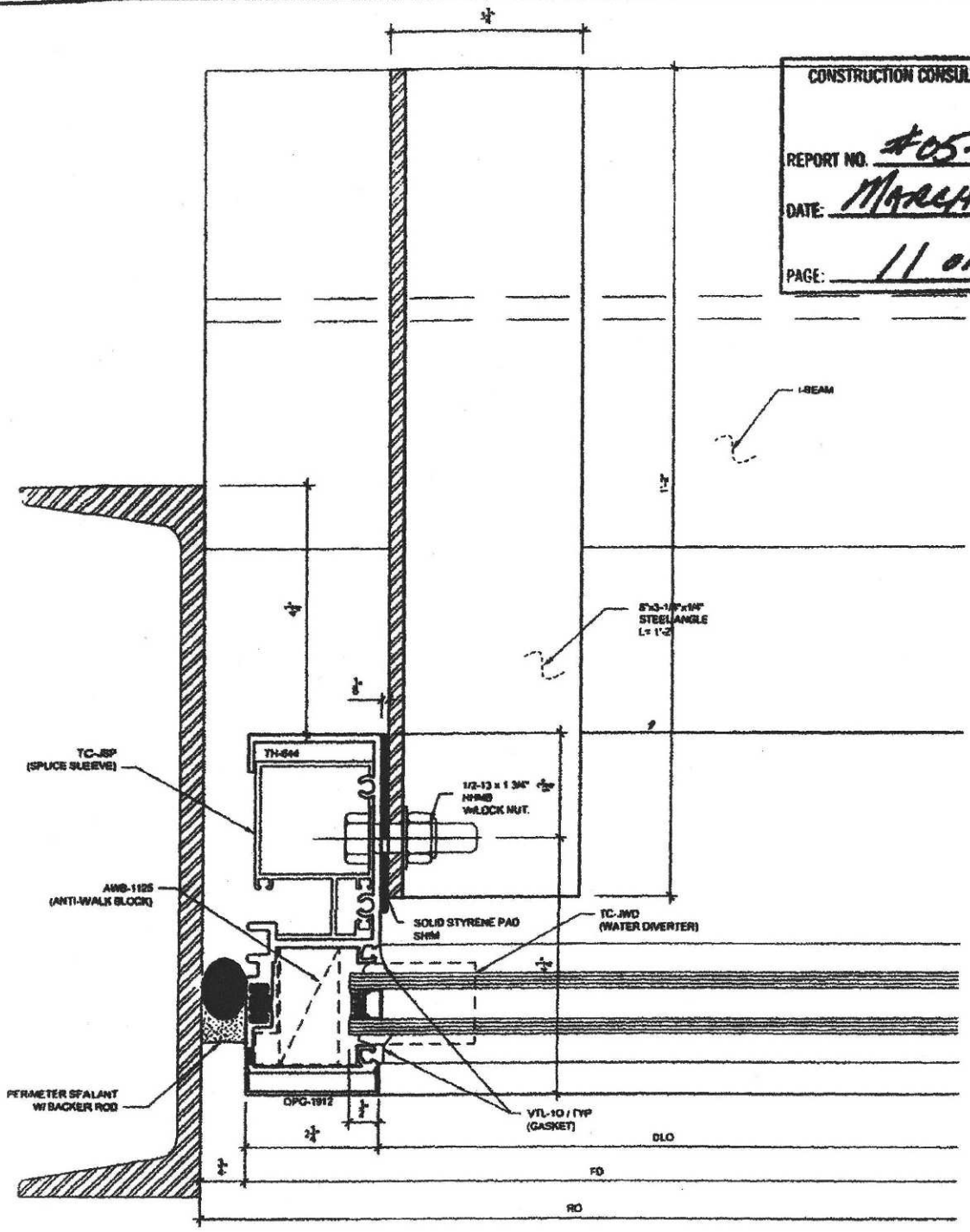

1 WALL JAMB W/ANCHOR

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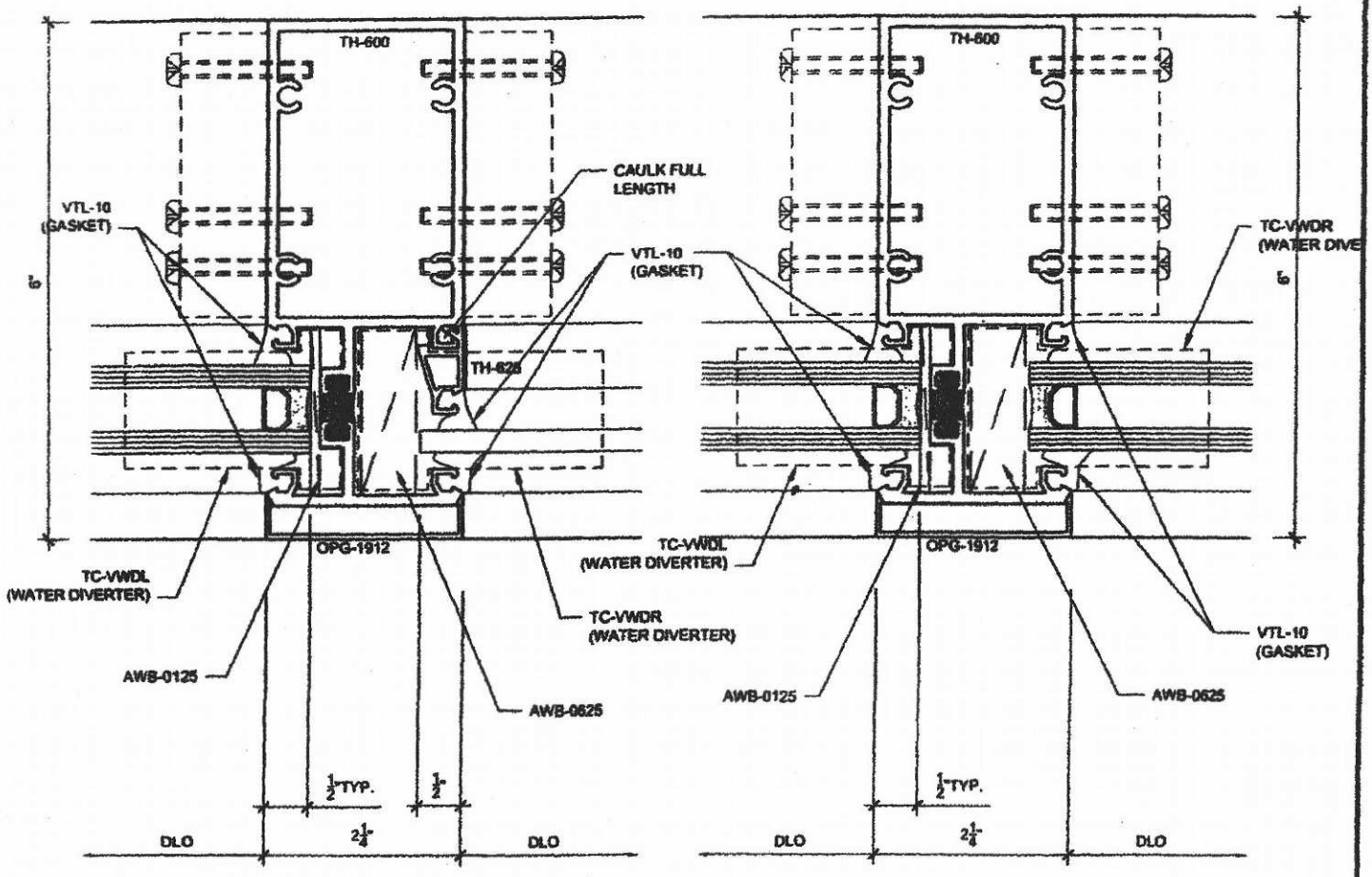

1 VERTICAL

2 VERTICAL

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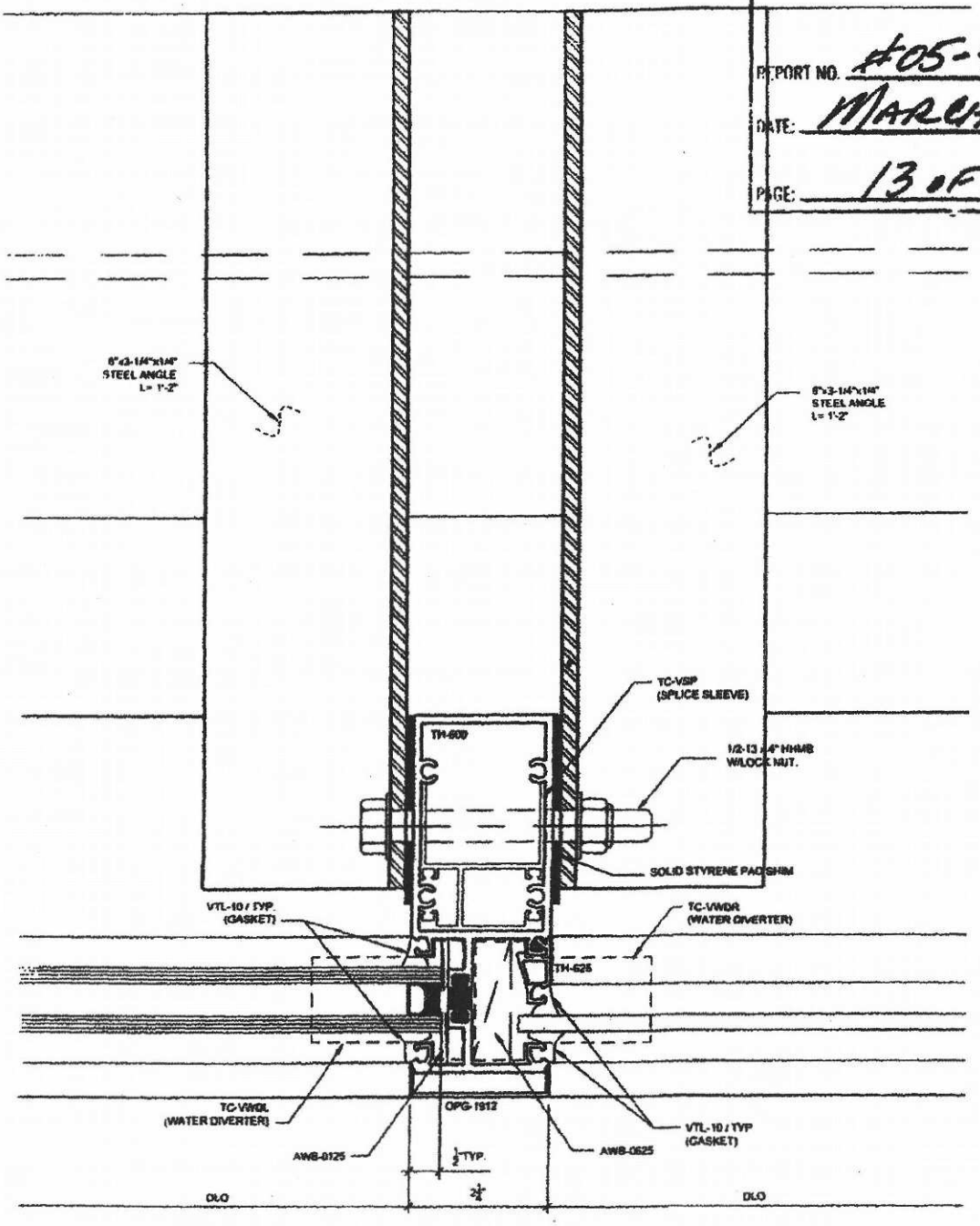

1 VERTICAL W/ANCHOR

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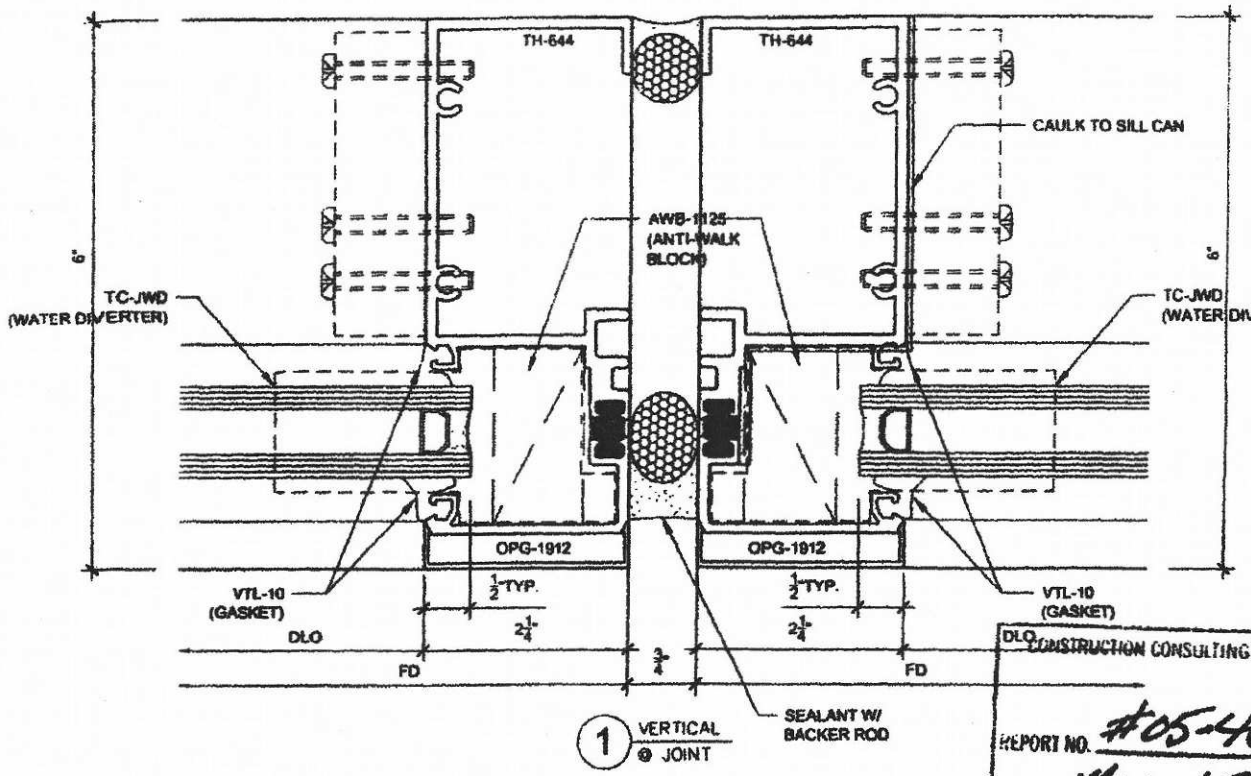

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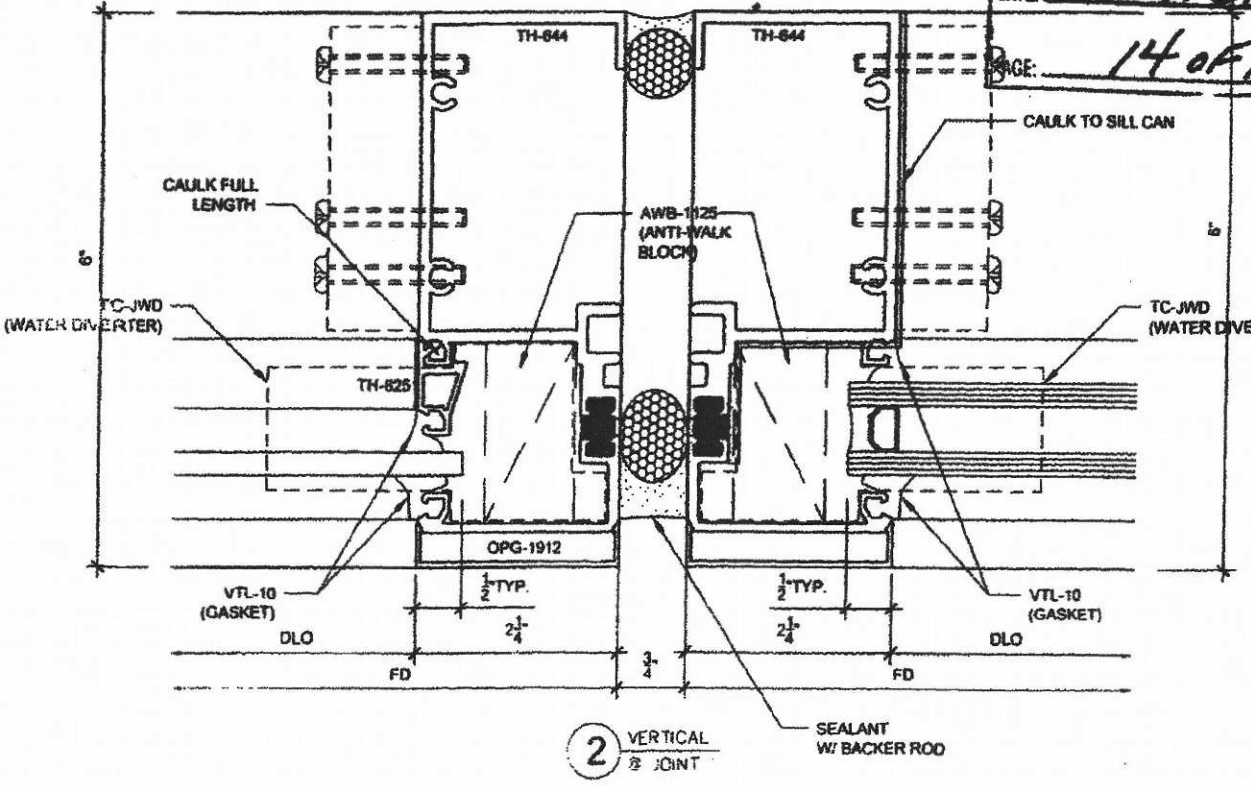

2 VERTICAL @ JOINT

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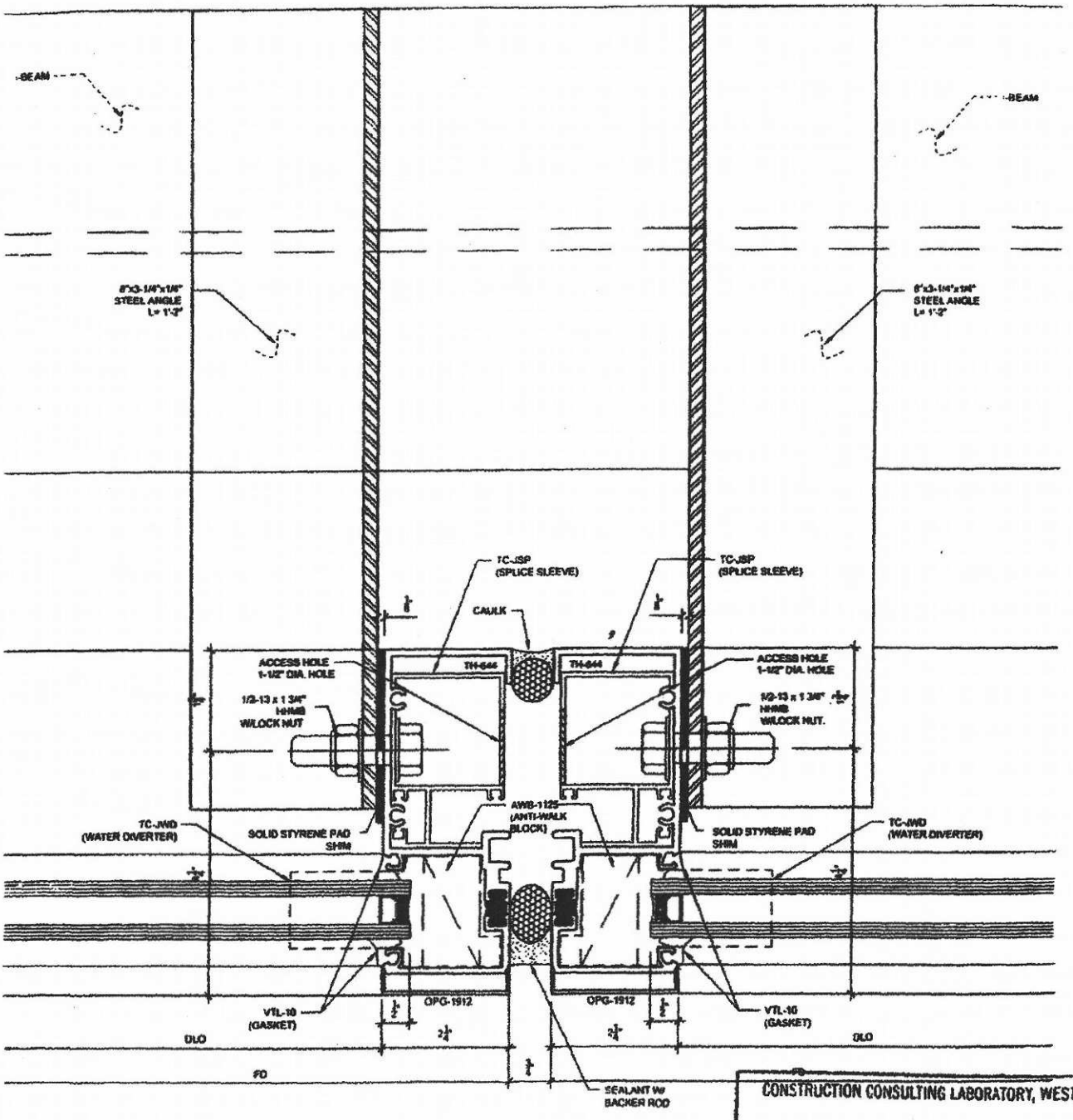

1 VERTICAL @ JOINT

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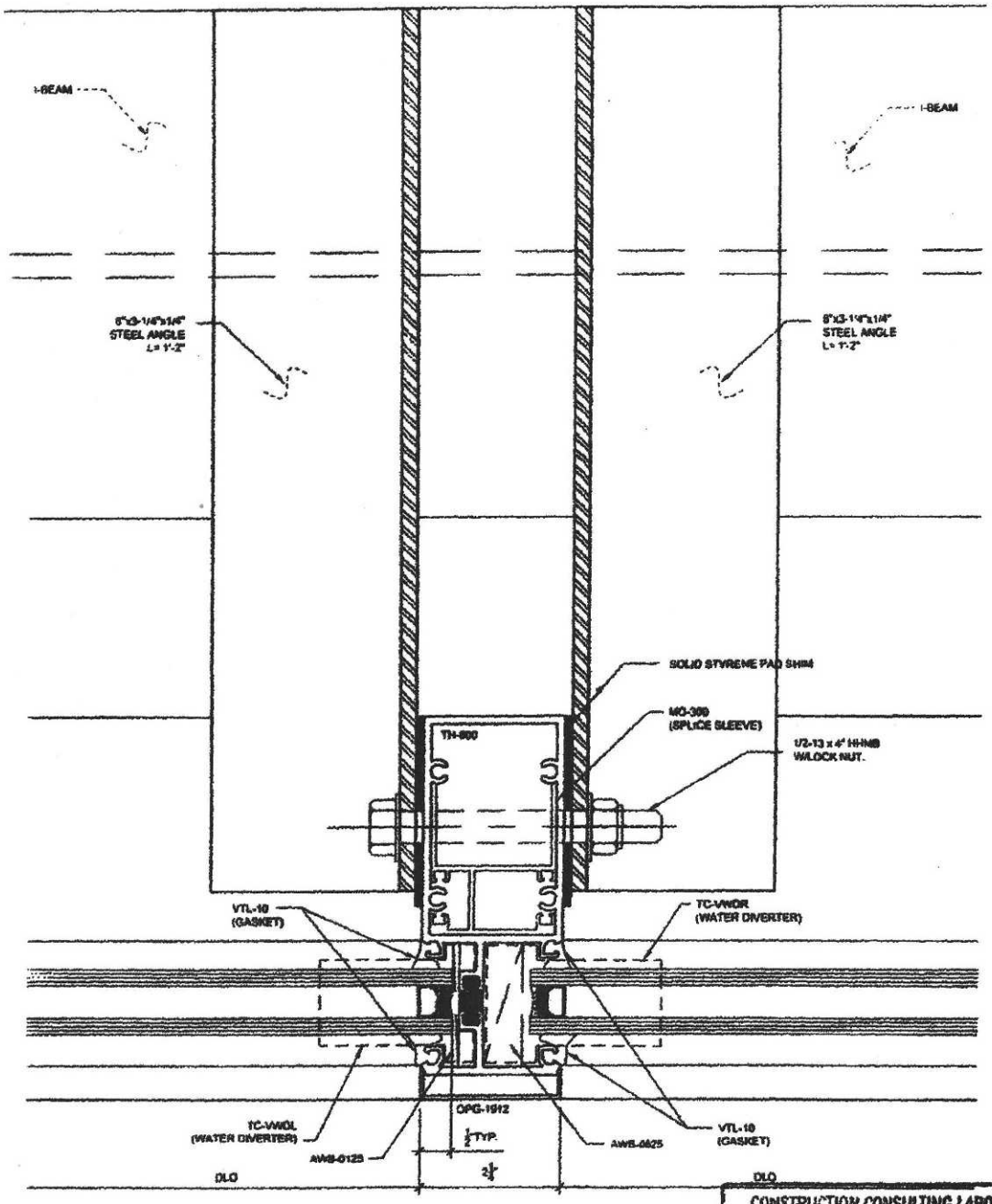

1 VERTICAL W/ANCHOR

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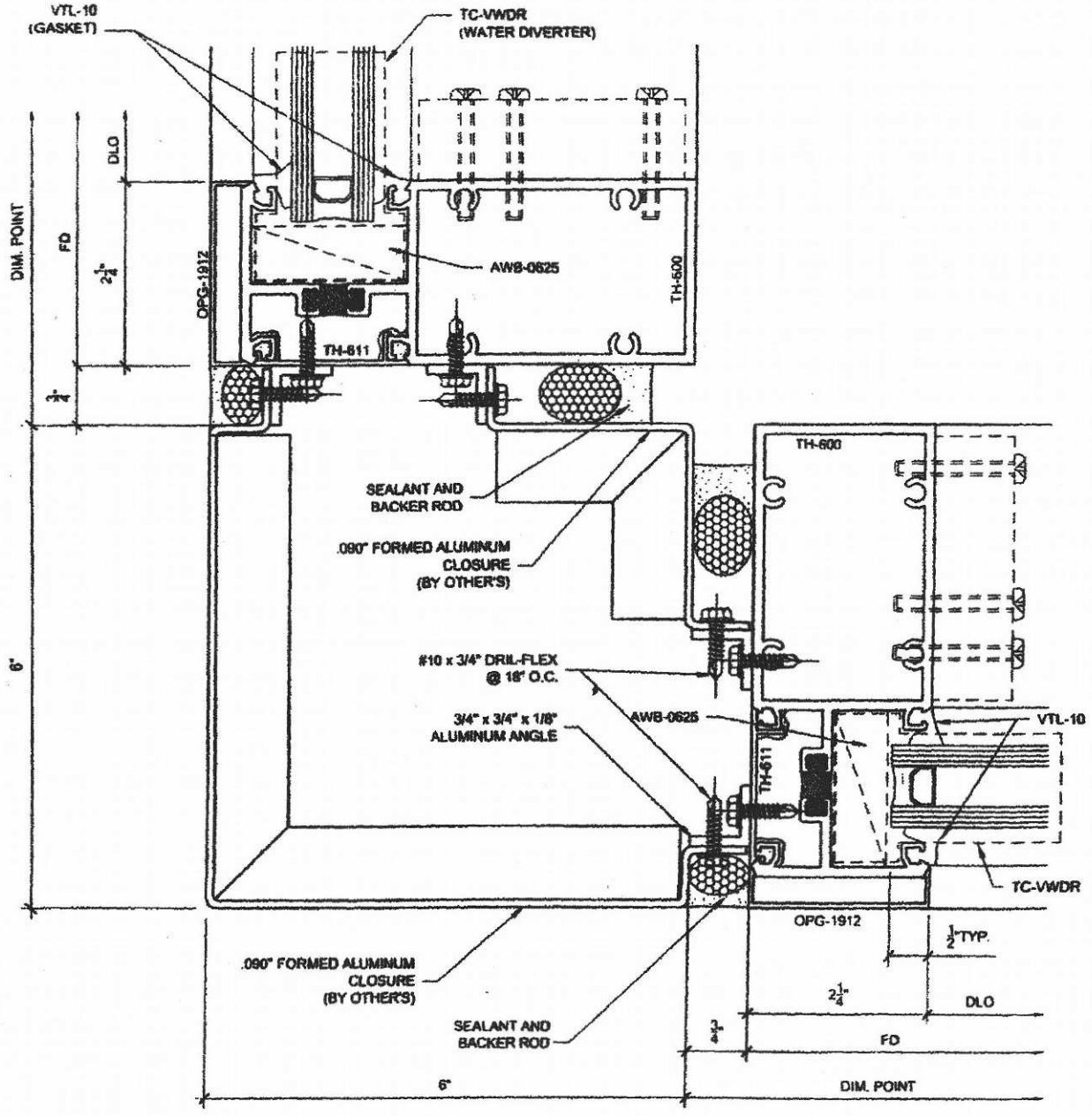

1 VERTICAL @ CORNER

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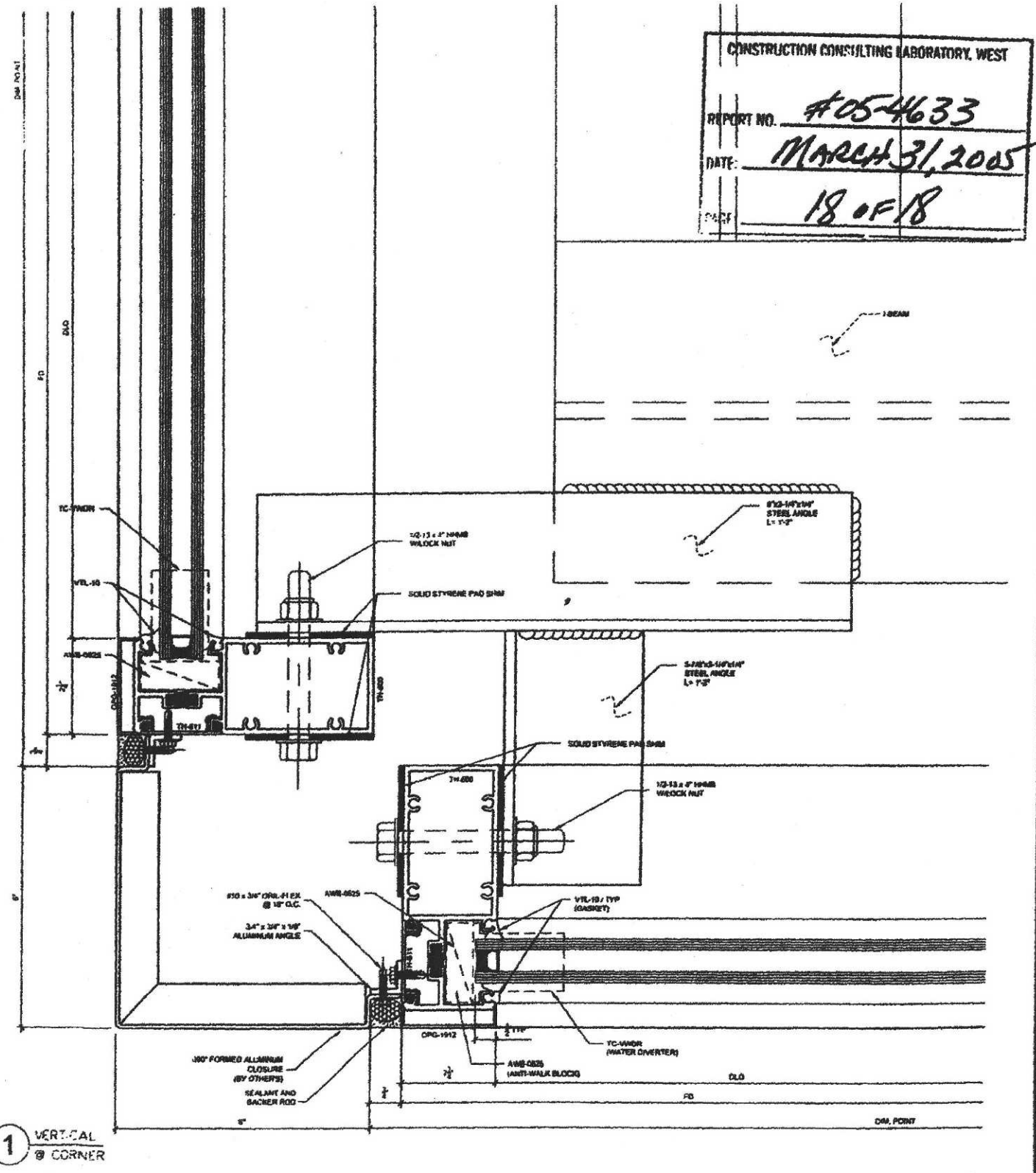

1 VERTICAL @ CORNER