URS/John A. Blume & Associates, Engineers

130 Jessie Street (at New Montgomery) San Francisco, California 94105

Date : 3/30/78

To: PG&E
77 Beale St.
San Francisco

Attention: Mr. Vince Ghio

Subject: Diablo Canyon
NRC Questions

GENTLEMEN:

We are enclosing X

We are forwarding under separate cover ....

Prints ....

Tracings ....

Preliminary Drawings ....

Specifications ....

Shop Drawings ....

Other X

AS FOLLOWS:

One (1) copy of the revised ductility calculations for the flow straighteners in response to Intake Structure Action Item 3 (3/30/78)

Sent by: Printer ....
Engineer's Messenger ....
Regular Mail ....
Airmail ....
Other ....

c.c. to

If items listed are not received please notify us at once.

By David A. Lang
David A. Lang

Sheet 1 of 1

URS/BLUME
130 Jessie Street (at New Montgomery)
San Francisco, California 94105

		SHEET NO.	
JOB NO. C902-26	JOB DIABLO INTAKE	BY DAL	DATE 3-30-78
CLIENT P.G.&E.	SUBJECT PIERS M-ϕ DUCTILITY	CHK'D	DATE

AN ESTIMATE WAS MADE OF THE REQUIRED LOCAL DUCTILITY OF THE FLOW STRAIGHTENERS BY THE FOLLOWING PROCEDURE:

1. AN ESTIMATE WAS MADE, USING THE CONSERVATION OF ENERGY APPROACH INHERENT IN THE RESERVE ENERGY TECHNIQUE, OF THE MAXIMUM INELASTIC DISPLACEMENT OF THE PIER AT ANY POINT RELATIVE TO THE DISPLACEMENT CORRESPONDING TO THE YIELD MOMENT OF THE SECTION. WE ESTIMATED THAT THE YIELD DISPLACEMENT WOULD INCREASE BY 30% WHEN SUBJECTED TO THE MAXIMUM COMPUTED MOMENT AT THE BASE.

2. USING MOMENT-AREA PRINCIPLES AND AN ASSUMED PLASTIC HINGE LENGTH OF 0.1 L, A LOCAL CURVATURE RATIO WAS COMPUTED. THIS RATIO IS THE CURVATURE OVER THE HINGE LENGTH RELATIVE TO THE CURVATURE AT YIELD AND CORRESPONDS TO THE REQUIRED LOCAL DUCTILITY. THE RATIO WAS CALCULATED AS 2.1, WELL WITHIN THE SPECIFIED LOCAL ALLOWABLE OF 6.

URS/BLUME
130 Jessie Street (at New Montgomery)
San Francisco, California 94105

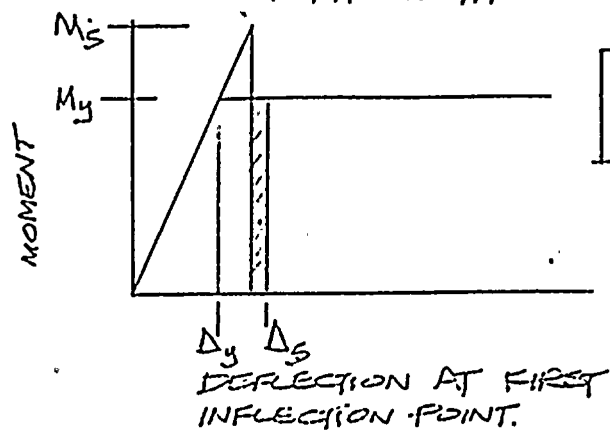
SHEET NO. 1/4

JOB NO. 0902-26 JOB DIABLO INTAKE — BY [illegible] DATE 3/27/78

CLIENT PG&E SUBJECT PIERS $M\phi$ - DUCTILITY — CHK'D DW DATE 3/28/78

FIND DUCTILITY AT THE BASE OF THE PIER THAT IS REQ'D TO ATTAIN THE REQ'D CURVATURE AT THE BASE.

1.) NEED ESTIMATE OF INELASTIC DISPLACEMENTS OF PIER, LIKE R.E.T. METHODS.



$$\frac{\Delta_s}{\Delta_y} = 1.3$$

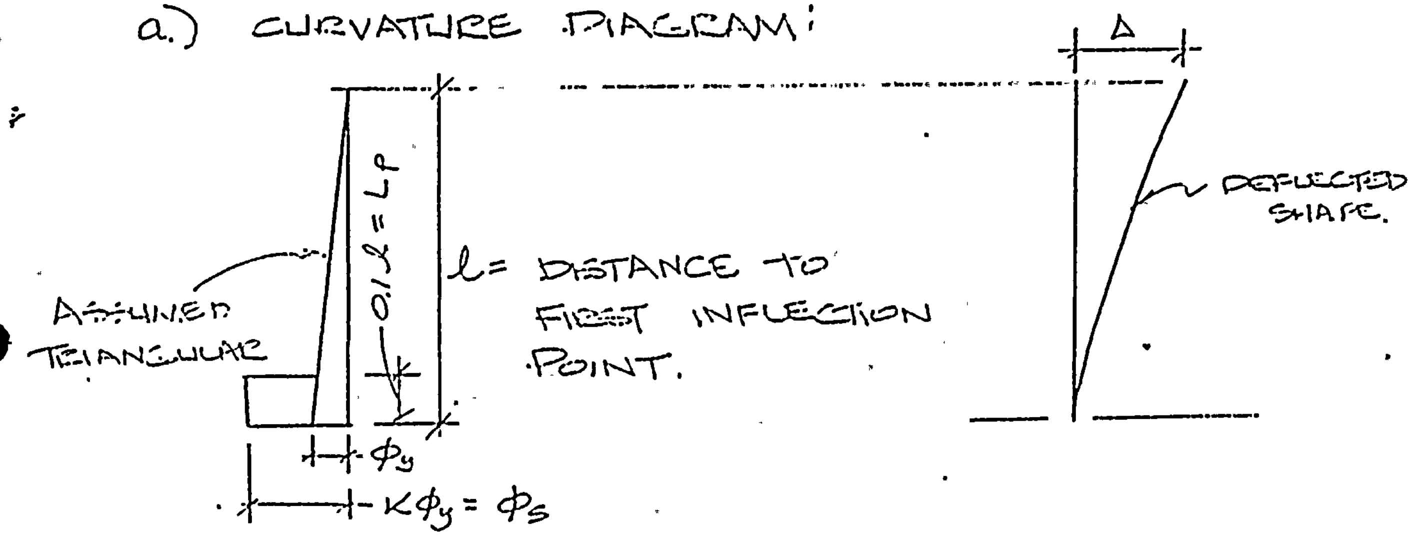
REFER TO THIRD SHEET. SINCE $\frac{f_s}{f_y} \cong \frac{M_s}{M_y} \cong \frac{\Delta_s}{\Delta_y}$. ELASTICALLY, THEN THE CALCULATIONS APPLY HERE, THE DIAGRAM AT LEFT WOULD GIVE THE SAME RESULTS.

2.) USING INELASTIC $M\phi$ THEORY, AND MOMENT AREA METHODS, FIND THE RATIO $\frac{\phi_s}{\phi_y}$, WHERE

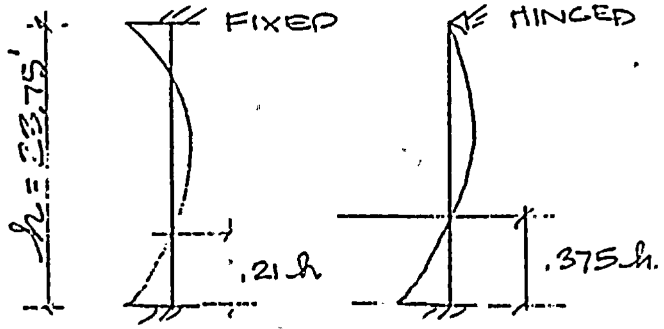
ϕ_s = INELASTIC CURVATURE.
ϕ_y = YIELD CURVATURE.

THIS RATIO IS THE LOCAL CURVATURE. DUCTILITY REQ'D AT THE BASE OF THE PIER.

a.) CURVATURE DIAGRAM:



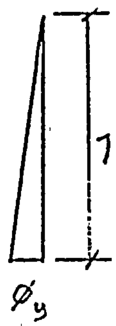
l IS ESTIMATED BY CONSIDERING MOMENT DIAGRAMS



$l \approx .3h = 7'$

$^* L_p = .1 l = .7'$

b.) CALCULATE Δ FOR ELASTIC PORTION OF CURVATURE DIAGRAM:



$$\Delta_{\phi_y} = \tfrac{1}{2}(7\times 12)\,\phi_y\ \tfrac{2}{3}(7\times 12) = 2352.\ \phi_y\ ''$$

c.) CALCULATE K, BY SETTING Δ_s (INELASTIC) $= 1.3\,\Delta_{\phi_y}$

$$1.3\,(\Delta_{\phi_y}) = \Delta_{\phi_y} + L_p\,(K-1)\,\phi_y\,(7 - \tfrac{.7}{2})\cdot 12$$

$$1.3\,(2352\,\phi_y) = 2352\,\phi_y + .7'(12)(K-1)\,\phi_y\,(7 - \tfrac{.7}{2})\cdot 12$$

$$3057 = 2352 + 670\,(K-1)$$

$$705 = 670\,(K-1)$$

$K - 1 = 1.1$

$K = 2.1$

$$\frac{\phi_s}{\phi_y} = 2.1$$

* L_p = PLASTIC HINGE LENGTH

REFER: Park & Paulay "Reinf. Concrete Struct." Wiley

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JOB NO. 0902-26 JOB DIABLO CANYON BY DAL DATE 11/2/77
CLIENT P.G.&E. SUBJECT INTAKE STRUCTURE CHK'D EHG DATE 11/2/77
REV. 3.29.78

DUCTILITY REQUIREMENTS
FOR FLOW STRAIGHTENERS (@ BASE)

N-S EQ

CASE I: $\Phi = 0.90$ NEWMARK 7.5M HOSGRI

$M = 2166^{K''}/FT$ (FROM COMPUTER OUTPUT)

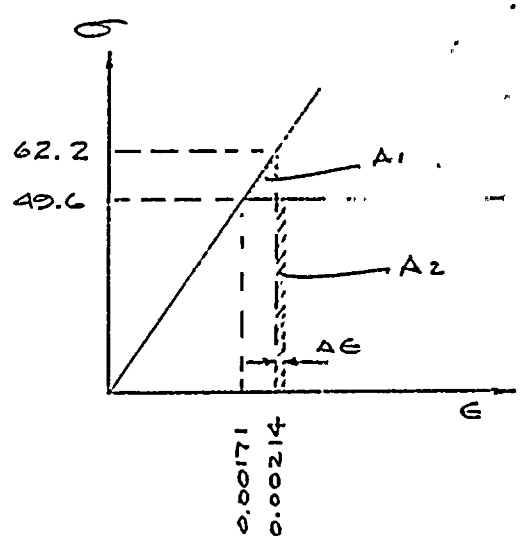
$M_u = 1726^{K''}/FT$ (COMPUTED CAPACITY)

YIELD STRESS = 49.6 KSI

$f_{REQ} = \frac{2166}{1726} \times 49.6 = 62.2$ KSI

$\epsilon_Y = \frac{49.6^{KSI}}{29 \times 10^3 \text{ KSI}} = 0.00171$ IN/IN

$\epsilon(f = 62.2) = \frac{62.2 \text{ KSI}}{29 \times 10^3 \text{ KSI}} = 0.00214$ IN/IN



DUCTILITY REQMTS

$$A_1 = (62.2 - 49.6)(0.00214 - 0.00171)/2 = 0.00271'$$

$$A_1 = A_2$$

$$\Delta\epsilon = \frac{A_1}{49.6} = 0.00005 \text{ IN/IN}$$

$$\epsilon + \Delta\epsilon = 0.00214 + 0.00005 = 0.00219 \text{ IN/IN}$$

$$\rho = \frac{0.00219}{0.00171} = 1.3$$ ← DUCTILITY REQ'D

CASE II : NEGLECT Φ FACTOR, SINCE STEEL AND CONCRETE STRENGTHS ARE KNOWN

$$M = 2166^{k'}/1'$$

$$M_u = 1918^{k'}/1' \text{ (COMPUTED)}$$

$$f_{REQ} = \frac{2166}{1918} \times 49.6 = 56.0^{KSI}$$

$$\epsilon(f = 56.0) = \frac{56.0}{29 \times 10^3} = 0.00193 \text{ IN/IN}$$

$$A_1 = (56 - 49.6)(0.00193 - 0.00171)/2 = 0.000704$$

$$\Delta\epsilon = \frac{A_1}{49.6} = 0.00001$$

$$\epsilon + \Delta\epsilon = 0.00193 + 0.00001 = 0.00194$$

$$\rho = \frac{0.00194}{0.00171} = 1.1$$