

COMMONWEALTH EDISON COMPANY

CALCULATION NO. L-000254 | PROJECT NO. 09066-272 | PAGE NO. 4

REVISION NO. 0 | | | |

PREPARED BY: *[Signature]* DATE: | REVIEWED BY: | DATE:

METHODOLOGY & ACCEPTANCE CRITERIA

Methodology

The girders support the purlins and roof.

The frequency is calculated using the following formula:

$$f = \frac{9.87}{2\pi} \sqrt{\frac{EIg}{Wl^3}}$$

Fundamental freq. of a  
Simply-supported beam  
with uniform wt =  $W/\text{length}$

Where  $E$  = modulus of Elasticity

$I$  = Moment of inertia

$g$  = acc. due to gravity in  $g$  units

$W$  = wt per unit length

$l$  = span of girder

$I$  is calculated for several typical girders and an average  $I$  is used ( $I$ s for girders are very close to each other).

ASSUMPTIONS - None

DESIGN INPUT

1. Drawings showing Girders Dimensions (Reference 1)
2. Roof weight (Reference 2)

REFERENCES

1. Drawing No S-560
2. Calculation No L-000246, 2-20-96

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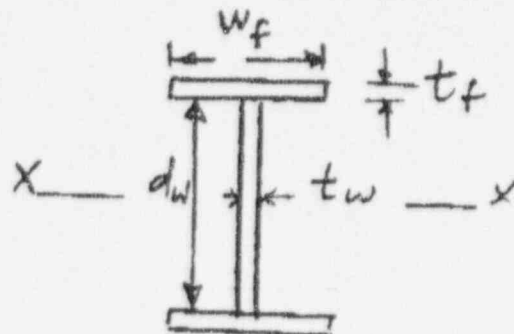
REVISION NO. 0 | | | |

PREPARED BY: *Smith* | DATE: | REVIEWED BY: | DATE:

CALCULATIONS

VERTICAL FREQUENCY OF TURBINE BUILDING ROOF

Roof is supported on GIRDERS spaced about 25' - 30' apart in N-S DIRECTION



GIRDER NO	$d_w$ (in)	$t_w$ (in)	$W_f$ (in)	$t_f$ (in)
TRG-193	70	5/16	12	2.125
TRG-192	70	5/16	14	1.875
TRG-194	70	5/16	12	2
TRG-196	70	5/16	12	1.9375

Flange Dimensions taken for central part 78 to 82' length (B), 1  
Drawing No S-560

Moment of Inertia about X-X

$$\begin{aligned}
 I_{TRG-193} &= \frac{5}{16} \times \frac{70^3}{12} + 12 \times 2.125 (35 + 1.062)^2 \times 2 \\
 &= 8932 + 66324 = 75256 \text{ in}^4 \\
 &= 3.63 \text{ Ft}^4
 \end{aligned}$$

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PREPARED BY: *Aditya* DATE: | REVIEWED BY: | DATE:

$$\begin{aligned} I_{TRG-192} &= \frac{5}{16} \times \frac{70^3}{12} + 14 \times 1.875 (35 + .937)^2 \times 2 \\ &= 8932 + 67802 = 76734 \text{ in}^4 \\ &= 3.7 \text{ Ft}^4 \quad \checkmark \end{aligned}$$

$$\begin{aligned} I_{TRG-194} &= \frac{5}{16} \times \frac{70^3}{12} + 12 \times 2 \times 36^2 \times 2 \\ &= 8932 + 62208 = 71140 \text{ in}^4 \\ &= 3.43 \text{ Ft}^4 \quad \checkmark \end{aligned}$$

$$\begin{aligned} I_{TRG-196} &= 8932 + 12 \times 1.9375 (35 + .968)^2 \times 2 \\ &= 69089 \text{ in}^4 \\ &= 3.33 \text{ Ft}^4 \quad \checkmark \end{aligned}$$

For overall frequency calculation use  
Average  $I = (3.63 + 3.7 + 3.43 + 3.33)/4$   
 $I = 3.52 \text{ Ft}^4 \quad \checkmark$

GIRDERS are spaced 26' - 30' spacing  
use average spacing of 28'  $\checkmark$

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PREPARED BY: *A Smith* DATE: | REVIEWED BY: | DATE:

Roof weight including

Supporting Steel members = 2800 kips

(Calc No L-000246, Rev0)

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Total length and width of Roof = 678' x 122'

Weight per ft of Girder length (with 28' spacing)

$$= \frac{2800}{122 \times 678} \times 28 = 0.95 \text{ k/ft}$$

frequency for simply supported beam

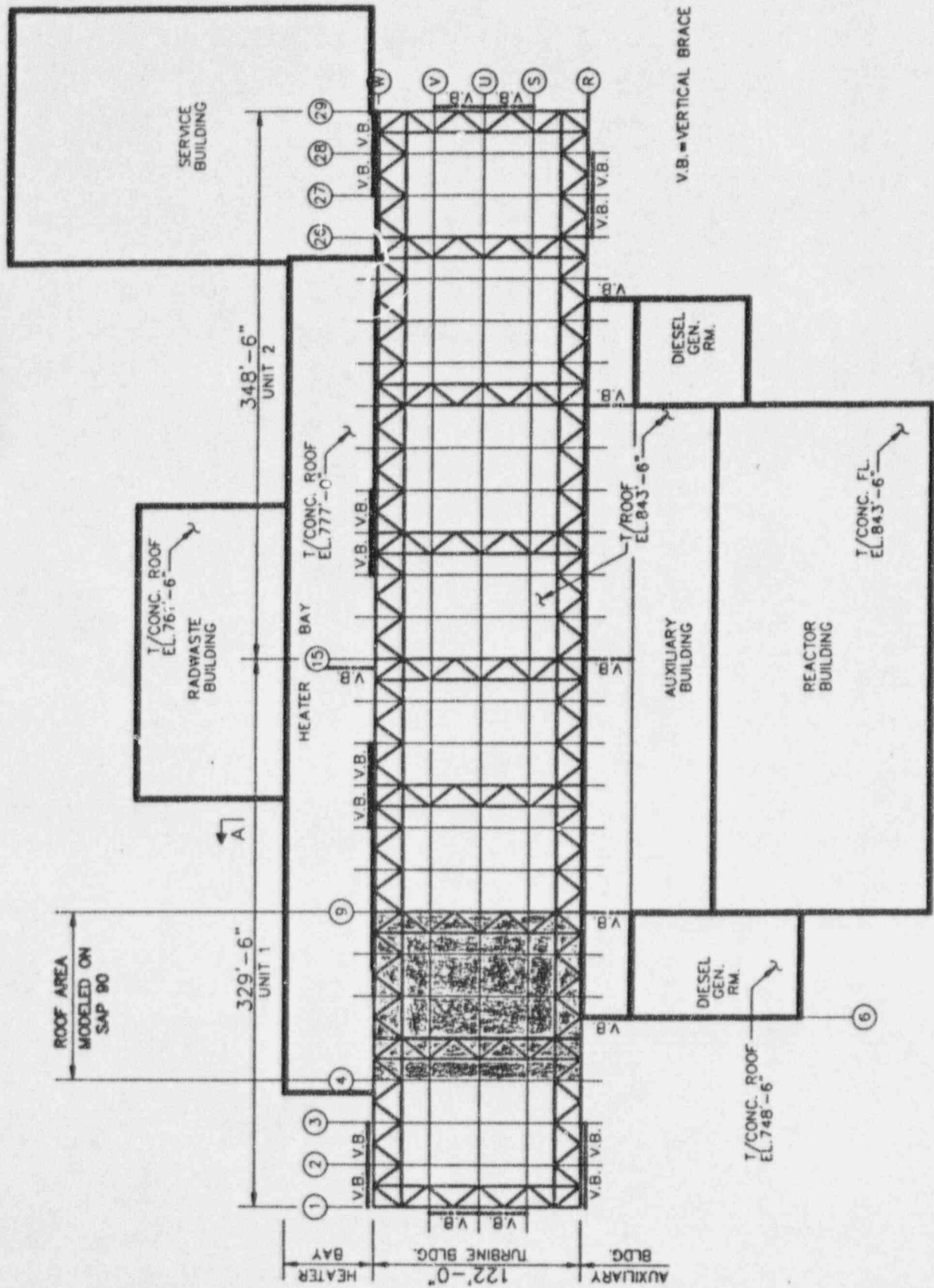
$$f = \frac{9.87}{2\pi} \sqrt{\frac{EI}{W L^4}} \quad \left[ \begin{array}{l} \text{Roark \& Young} \\ \text{Formulas for} \\ \text{stress \& strain} \end{array} \right]$$

$$= \frac{9.87}{2\pi} \sqrt{\frac{4.176 \times 10^6 \times 3.52 \times 32.2}{0.95 \times 122^4}}, l = 122'$$

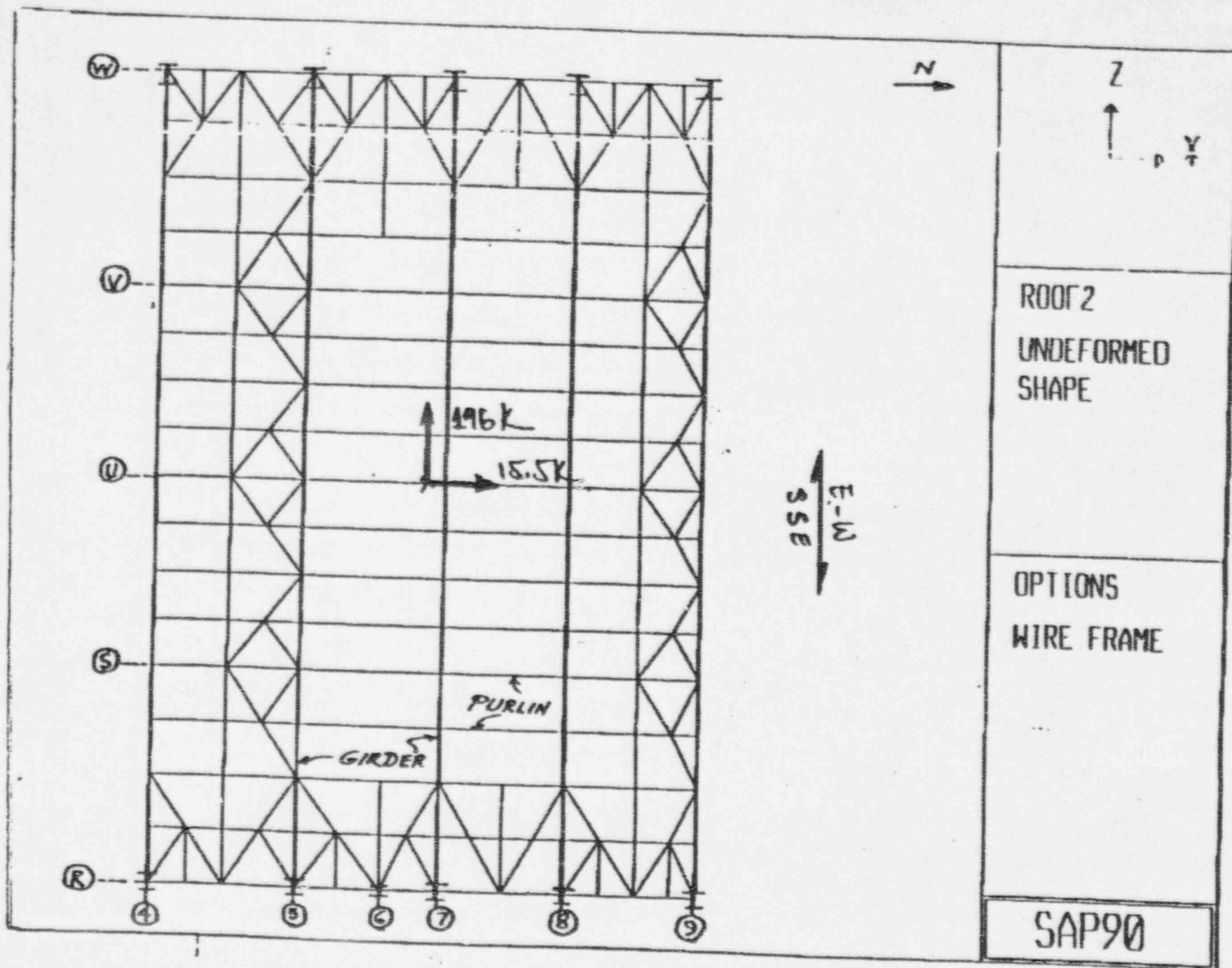
$$f = 2.36 \text{ hz.}$$

SUMMARY & CONCLUSION

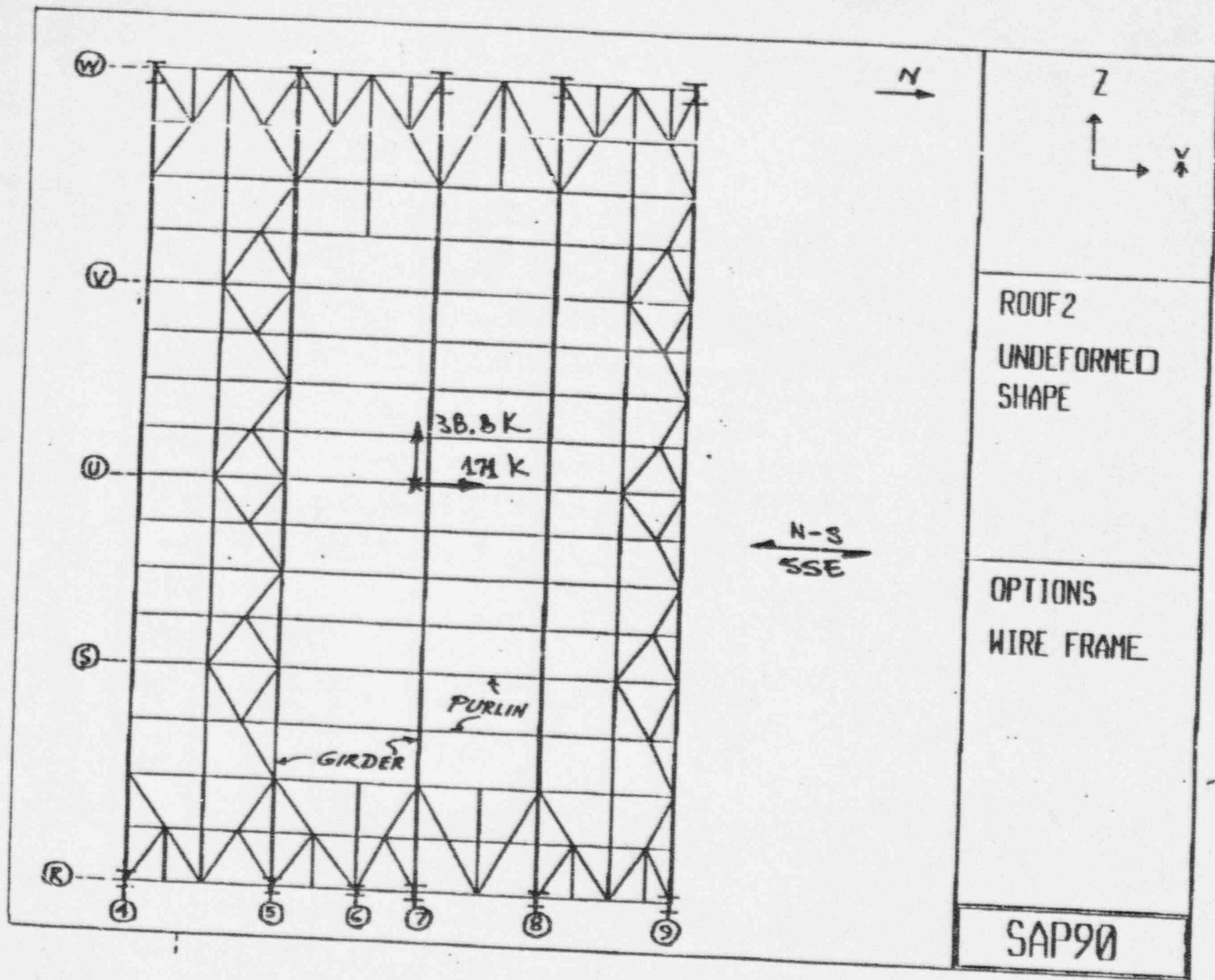
1. The vertical frequency of the Turbine Building Roof is 2.36 hz.
2. The above frequency matches closely with the frequency obtained from the finite element response spectrum analysis of the roof, documented in calculation No L-000256, dated 2-23-96; i.e. 2.45 hz.



PLAN (TURBINE BUILDING ROOF)  
(N.T.S.)





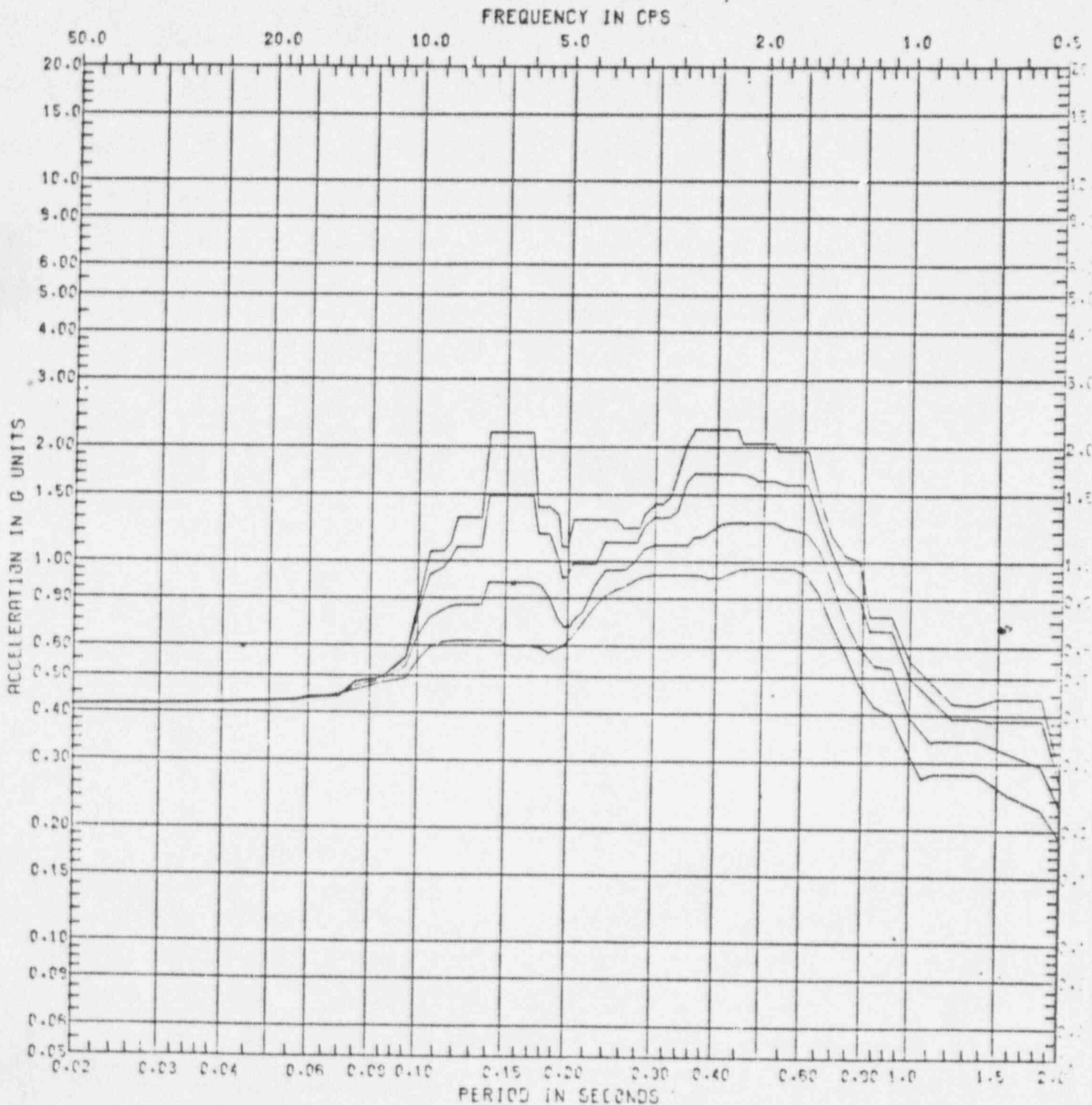


SARGENT & LUNDY  
ENGINEERS

19 DEC 79  
447BFH

SAFETY RELATED

LAS AUX. BLDG. ROOF EL 843.5 SSE E-W  
DESIGNER *B. Henley* CHECKER *G. Ehlert*  
DESIGN SPECTRA AT JOINT/SLAB 5  
PEAKS WIDENED BY 10% ON EACH SIDE  
DAMPING 0.010 0.020 0.050 0.100  
PAGE C-110E OF  
Calc. 163  
Project Nos. 4266/4267  
Rev. 2



HORIZONTAL RESPONSE SPECTRA  
DESIGN BASIS EARTHQUAKE  
EAST-WEST COMPONENT  
ELEVATION 843'-6"  
AUXILIARY BUILDING ROOF  
TURBINE BUILDING ROOF

SPECTRA NO.  
126-DB-EW

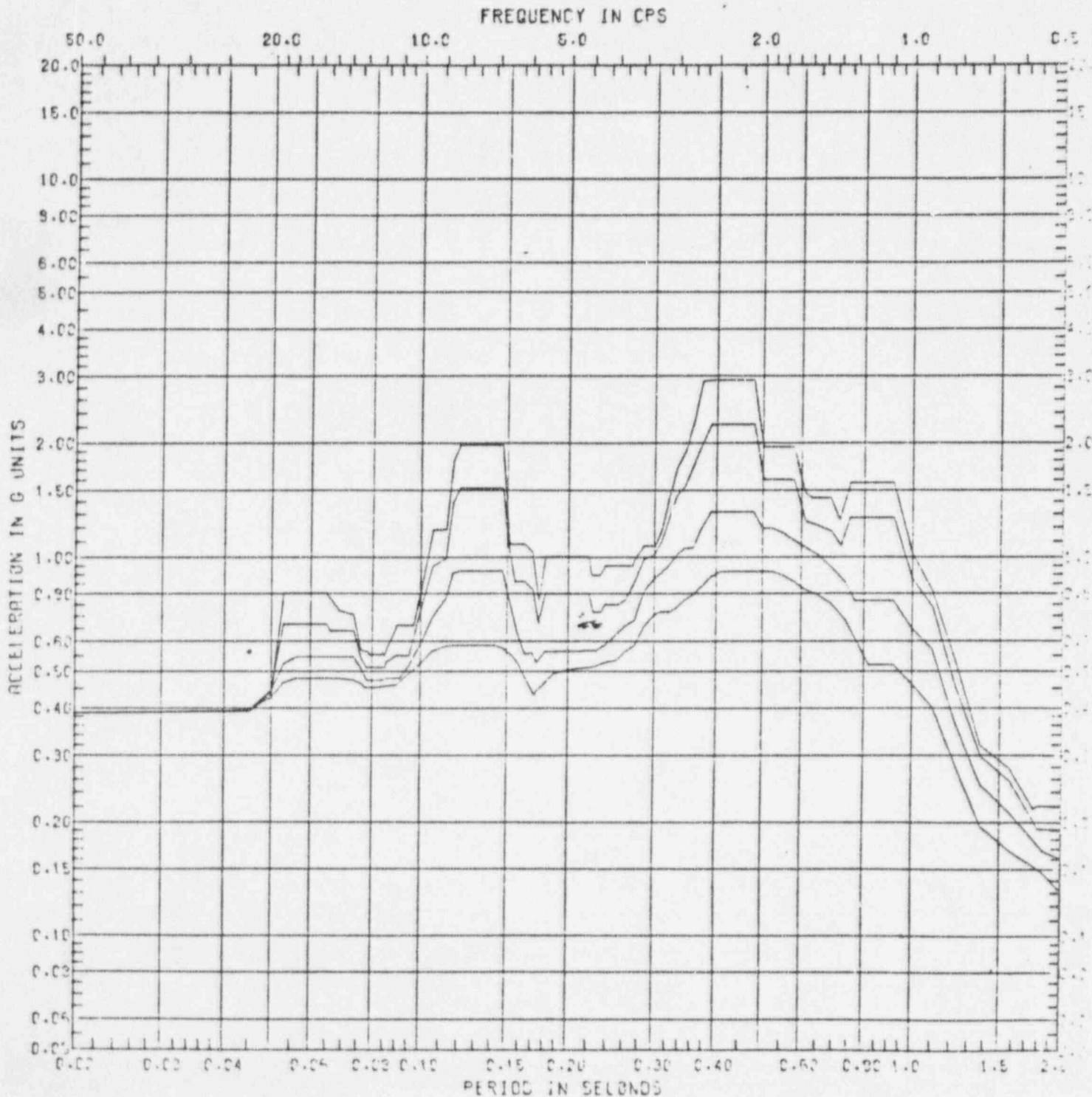


SARGENT & LUNDY  
ENGINEERS

19 DEC 79  
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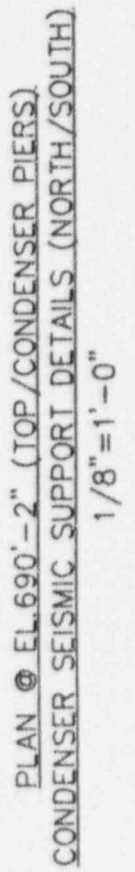
LAS AUX. BLDG. ROOF EL 843.5 SSE N-S  
DESIGNER *B. Hurley* CHECKER *G. Ehlert*  
DESIGN SPECTRA AT JOINT/SLAB 9  
PEAKS WIDENED BY 10% ON EACH SIDE  
DAMPING 0.010 0.020 0.050 0.100  
PAGE C-110D OF  
Calc. 163  
Project Nos. 4266/4267  
Rev. 2

SAFETY RELATED



HORIZONTAL RESPONSE SPECTRA  
DESIGN BASIS EARTHQUAKE  
NORTH-SOUTH COMPONENT  
ELEVATION 843'-6"  
AUXILIARY BUILDING ROOF  
TURBINE BUILDING ROOF

SPECTRA NO.  
126-DE-NS

 $1/8'' = 1'-0''$

