

Design Analysis
Ginna Station
Structural Upgrade Program

ROCHESTER GAS AND ELECTRIC CORPORATION
- 89 EAST AVENUE
ROCHESTER, NEW YORK 14649

EWR #3296

Revision 0

January 19, 1989

Prepared By: L. A. Sucheski 1/19/89
Structural Engineering Date

Reviewed By: J. R. Luper 1-24-89
Structural Engineering Date

Approved By: A. G. Luper 1/24/89
Manager, Structural Engineering Date



REVISION STATUS SHEET

Page Latest
Rev.

i 0

ii 0

1 0

2 0

3 0

4 0

5 0

6 0

7 0

8 0

D 9 0

10 0

11 0

12 0

13 0

Page

Latest
Rev.

Page

Latest
Rev.



Design Analysis

1.0 Objective

The purpose of this calculation is to assess the impact on the seismic analysis that was performed for Ginna Station due to the modifications that were installed for the Structural Upgrade Program.

2.0 Design Inputs

2.1 Design Analysis, EWR #3296, Revision 1, May 22, 1987.

2.2 Safety Analysis, EWR #3296, Revision 0, May 22, 1987.

3.0 Referenced Documents

3.1 Gilbert Associates, Inc. Report "Seismic Upgrade Program Auxiliary Structures Seismic Analysis - May 15, 1980".

3.2 RG&E drawing #33013-1641, "Structural Upgrade Program - Auxiliary Building North Wall".

4.0 Assumptions

Listed as made. See Body.

5.0 Computer Codes

None.

6.0 Analysis

See Body.

7.0 Results

See Conclusions at the end of analysis.

LAS/A009

ENG. DEPT.	STATION: GINNA STATION	DATE: 12/29/88	PAGE 1 OF
JOB: STRUCTURAL UPGRADE EWT 3296		MADE BY: LAS	CK:

THE STRUCTURAL UPGRADE PROGRAM FOR EXTREME ENVIRONMENTAL LOADS INVOLVED MODIFICATIONS TO SOME OF THE MAIN STRUCTURAL ELEMENTS. SPECIFICALLY, 265 MODIFICATIONS WERE MADE. THE STRUCTURES OF THE MAIN PLANT CONSIST OF REINFORCED CONCRETE BELOW GRADE AND "SIMPLE" FRAMING, TRUSS TYPE STRUCTURAL STEEL FRAMING ABOVE GRADE. THE MODIFICATIONS TO THE STRUCTURE THAT WERE MADE CONSISTED OF LOCALIZED STRENGTHENING OF PRIMARY MEMBER, CONNECTIONS AND ANCHORAGE.

TYPICAL MODIFICATIONS WERE AS FOLLOWS:

PRIMARY MEMBERS

- STRENGTHENING OF TENSION FLANGES OF BENDING ELEMENTS

STRENGTHENING OF COMPRESSION FLANGES OF BENDING ELEMENTS

CONNECTIONS

STRENGTHENING OF CLIP ANGLE CONNECTIONS TO INCREASE THEIR TENSION/SHEAR CAPACITY

ANCHORAGES

STRENGTHENING OF MAIN STEEL ANCHORAGES TO INCREASE THEIR TENSION/SHEAR CAPACITY

ENG. DEPT.	STATION: GINNA STATION	DATE: 12/29/88	PAGE 2 OF
JOB: STRUCTURAL UPGRADE EWR 3296	MADE BY: LAS	CK:	

ALL OF THESE TYPICAL MODIFICATION DO NOT ALTER THE OVERALL BUILDING STIFFNESS SINCE THEY ARE QUITE LOCALIZED. THE PRIMARY LATERAL LOAD RESISTING COMPONENTS FOR THE SUPERSTRUCTURE ARE CROSS BRACES LOCATED THROUGHOUT THE BUILDING. CROSS BRACING WAS NOT MODIFIED BY THESE TYPICAL FIXES.

HOWEVER, ADDITIONAL WEIGHT (MASS) WAS ADDED.

COMPARE THE ADDITIONAL WEIGHT WITH THE ORIGINAL WEIGHTS USED IN THE SEISMIC MODEL.

REFERENCE "PIPING SEISMIC
PROGRAM - AUXILIARY STRUCTURES
SEISMIC ANALYSIS"
EWR 2512

ORIGINAL MODEL (STEEL) WEIGHTS

BUILDING	WEIGHT
SERVICE	940 K
TURBINE	113 + 563 + 472
AUXILIARY	340 + 553
INTERMEDIATE	280
TOTAL	3260 K

ENG. DEPT.	STATION: GINNA STATION	DATE: 12/29/88	PAGE 3 OF
JOB: STRUCTURAL UPGRADE EWR 3296	MADE BY: LAS	CK:	

ADDITIONAL WEIGHT DUE TO
STRUCTURAL UPGRADE = 36.8K

$$\text{PER CENT CHANGE} = \frac{36.8}{3260} \times 100\% \\ = 1.1\%$$

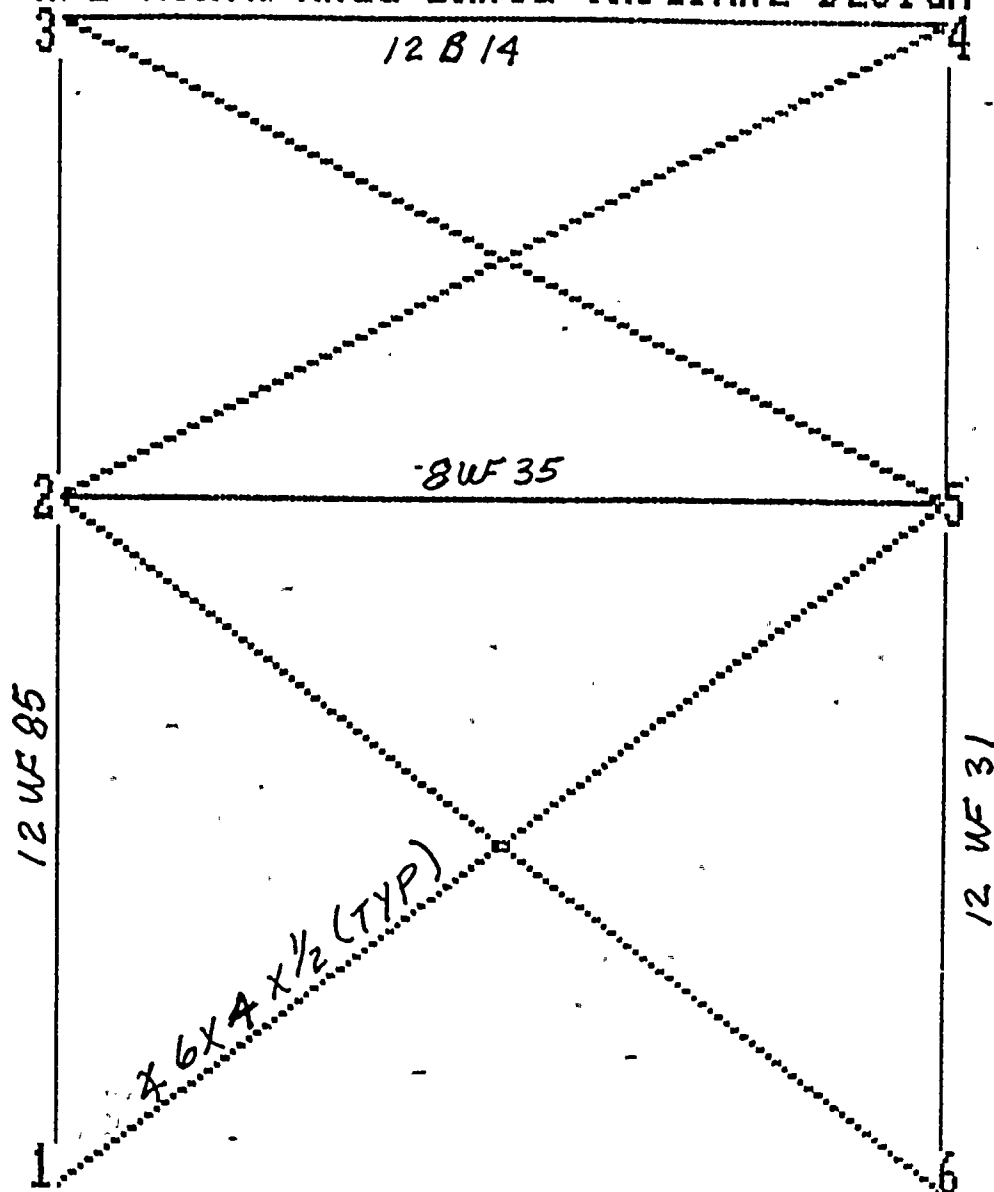
THIS SMALL CHANGE IS
NOT SUFFICIENT TO ALTER
THE BUILDING RESPONSE.

ONLY ONE MODIFICATION IN THE
PROGRAM HAS RESULTED IN
A STIFFNESS CHANGE (REF. DWG 33013-1641).
THIS MODIFICATION OCCURS IN THE NORTH
WALL OF THE AUXILIARY BUILDING. THE
ORIGINAL AND REVISED DESIGNS ARE
SHOWN ON THE FOLLOWING PAGES WHICH
SHOW ANALYTICAL STRESS MODELS OF
EACH.

THE BRACED BAY IN QUESTION ACTS
IN THE EAST-WEST DIRECTION. IN
ORDER TO DETERMINE THE INFLUENCE
OF THE MODIFICATION THE FOLLOWING
STEPS WILL BE TAKEN:

1. DETERMINE THE ORIGINAL
STIFFNESS OF THE AUXILIARY
BUILDING IN THE EAST-WEST DIRECTION.

A/B NORTH WALL BRACE ORIGINAL DESIGN



TITLE STIFFNESS CHANGE AUX BLDG NORTH WALL BRACING ORIGINAL DESIGN
NODAL POINT LOCATION 1

1 0 0 0
2 0 292 0
3 0 492 0
4 0 492 0
5 0 292 0
6 308 0 0

MATERIAL PROPERTIES 30E6 11.6E6 0 0.3 36000

BEAM TYPE 1 24.98 1 723 235

CONNECT 1 TO 2

CONNECT 2 TO 3

BEAM TYPE 1 9.12 1 238 19.8

CONNECT 4 TO 5

CONNECT 5 TO 6

BEAM TYPE 1 10.3 1 126 43

RELEASE V.W

CONNECT 2 TO 5

BEAM TYPE 1 4.14 1 88.2 2.25

RELEASE V.W

CONNECT 3 TO 4

BEAM TYPE 1 4.8 1 17.4 6.3

RELEASE V.W

CONNECT 1 TO 5

BEAM TYPE 1 4.8 1 17.4 6.3

RELEASE V.W

CONNECT 2 TO 6

BEAM TYPE 1 4.8 1 17.4 6.3

RELEASE V.W

CONNECT 2 TO 4

BEAM TYPE 1 4.8 1 17.4 6.3

RELEASE V.W

CONNECT 3 TO 5

ZERO 1

RX 1 THROUGH 6

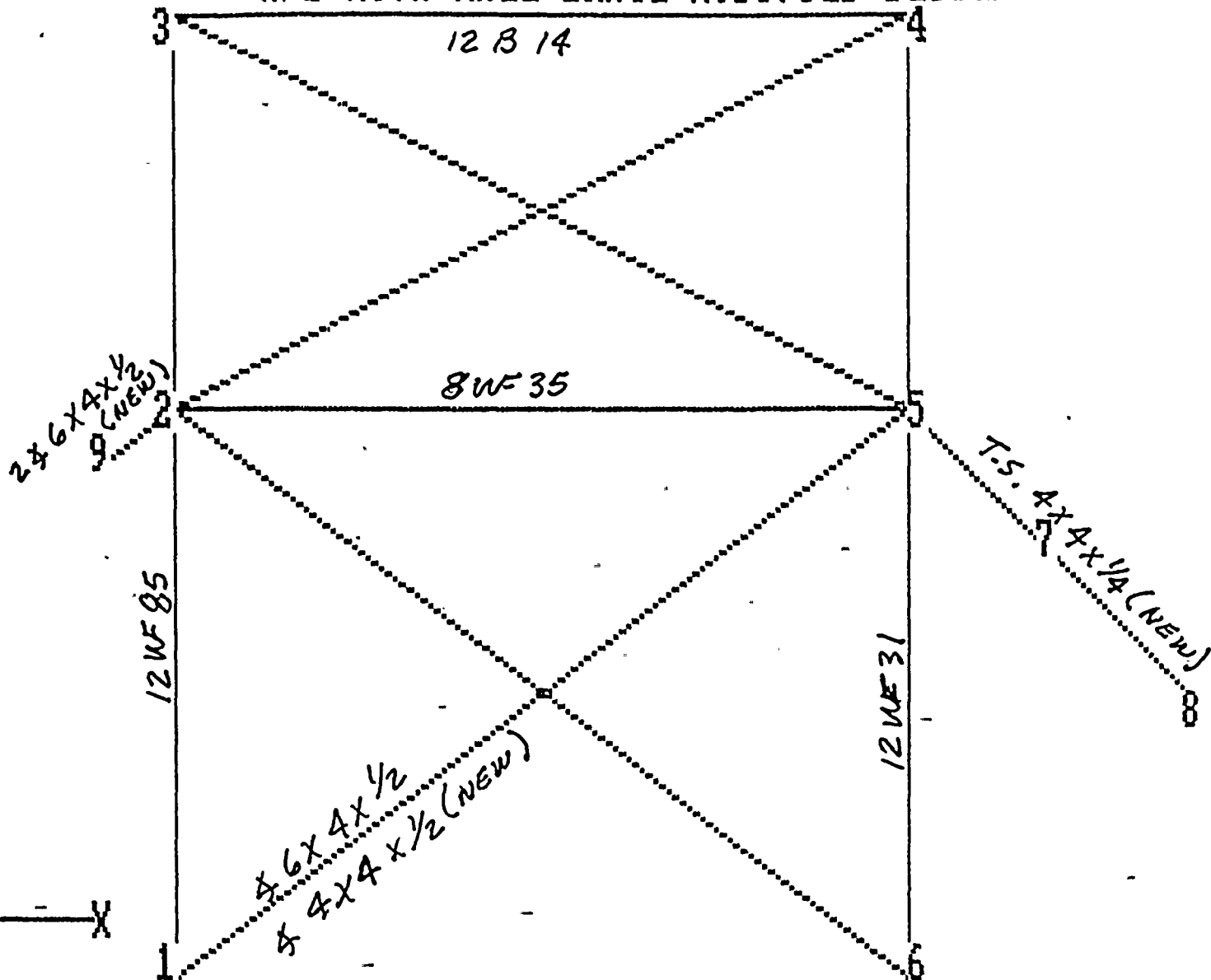
RY 1 THROUGH 6

ELIMINATE

END DEFINITION



A/B NOTH WALL BRACE MODIFIED DESIGN





TITLE STIFFNESS CHANGE AUX BLDG NORTH WALL BRACING MODIFIED DESIGN
NODAL POINT LOCATION 1

1 0 0 0
2 0 292 0
3 0 492 0
4 0 492 0
5 0 292 0
6 308 0 0
7 367 221 0
8 427 148 0
9 -28 264 0

MATERIAL PROPERTIES 30E6 11.6E6 0 0.3 36000

BEAM TYPE 1 24.98 1 723 235

CONNECT 1 TO 2

CONNECT 2 TO 3

BEAM TYPE 1 9.12 1 238 19.8

CONNECT 4 TO 5

CONNECT 5 TO 6

BEAM TYPE 1 10.3 1 126 43

RELEASE V,W

CONNECT 2 TO 5

BEAM TYPE 1 4.14 1 88.2 2.25

RELEASE V,W

CONNECT 3 TO 4

BEAM TYPE 1 8.5 1 26.6 42.6

RELEASE V,W

CONNECT 1 TO 5

BEAM TYPE 1 4.8 1 26.6 42.6

RELEASE V,W

CONNECT 2 TO 6

BEAM TYPE 1 8.5 1 26.6 42.6

RELEASE V,W

CONNECT 2 TO 4

BEAM TYPE 1 8.5 1 26.6 42.6

RELEASE V,W

CONNECT 3 TO 5

BEAM TYPE 1 3.6 1 8.22 8.22

RELEASE V

CONNECT 5 TO 7

BEAM TYPE 1 3.6 1 8.22 8.22

RELEASE V

CONNECT 8 TO 7

BEAM TYPE 1 9.5 1 34.6 26.2

RELEASE V

CONNECT 2 TO 9

ZERO 11

RX 1 THROUGH 9

RY 1 THROUGH 9

ELIMINATE

END DEFINITION



STIFFNESS CHANGE AUX BLDG NORTH WALL BRACING MODIFIED DESIGN

STATIC ANALYSIS SUBCASE NO. 1 APPLIED FORCES

NODE	DIR	VALUE	NODE	DIR	VALUE	NODE	DIR	VALUE
2	X T	1.000E+04						

STATIC ANALYSIS SUBCASE NO. 1 DISPLACEMENTS

NODE	X TRANS	Y TRANS	Z TRANS	X ROT	Y ROT	Z ROT
1	0.0000E-01	0.0000E-01	0.0000E-01	0.0000E-01	0.0000E-01	-8.3908E-05
2	1.7296E-02	3.3489E-03	0.0000E-01	0.0000E-01	0.0000E-01	-9.8823E-06
3	2.7018E-02	4.0183E-03	0.0000E-01	0.0000E-01	0.0000E-01	-6.7978E-05
* 4	3.6649E-02	-7.1921E-03	0.0000E-01	0.0000E-01	0.0000E-01	-1.0659E-04
5	1.3714E-02	-4.2913E-03	0.0000E-01	0.0000E-01	0.0000E-01	-2.8471E-05
6	0.0000E-01	0.0000E-01	0.0000E-01	0.0000E-01	0.0000E-01	-5.3048E-05
7	1.4164E-02	3.7888E-03	0.0000E-01	0.0000E-01	0.0000E-01	1.5433E-07
8	0.0000E-01	0.0000E-01	0.0000E-01	0.0000E-01	0.0000E-01	-2.1197E-04
9	2.0607E-02	0.0000E-01	0.0000E-01	0.0000E-01	0.0000E-01	1.8333E-04

ENG. DEPT.	STATION: GINNA STATION	DATE: 12/29/88	PAGE 10 OF
JOB: STRUCTURAL UPGRADE EWR 3296		MADE BY:	CK:

2. DETERMINE THE CHANGE IN THIS STIFFNESS DUE TO THIS MODIFICATION

3. DETERMINE THE PER CENT CHANGE IN THE FUNDAMENTAL FREQUENCY OF THE BUILDING.

FROM
REF. INFORMATION IS TAKEN THE "AUXILIARY
STRUCTURES SEISMIC ANALYSIS" EWR 2512

THE AUX. BLDG STEEL IS REPRESENTED
BY TWO LUMPED MASSES IN THE SEISMIC
MODEL.

WEIGHT OF LOW ROOF = 340 K

EAST-WEST ACCELERATION
OF THE LOW ROOF = 0.473g

MAX: E-W DISPLACEMENT
OF THE LOW ROOF = 0.652 IN

$$\begin{aligned} \text{E-W STIFFNESS OF THE} \\ \text{LOW ROOF} &= K_{LR} = \frac{(340 \text{ K})(0.473)}{0.652 \text{ IN}} \\ &= 247 \text{ K/IN} \end{aligned}$$



ENG. DEPT.	STATION: GINNA STATION	DATE: 12/27/88	PAGE 11 OF
JOB: STRUCTURAL UPGRADE EWR 3296		MADE BY: LAS	CK:

WEIGHT OF THE HIGH ROOF = 554^k

E-W ACCELERATION OF
THE HIGH ROOF = 0.496g

MAX E-W DISPLACEMENT
OF THE HIGH ROOF = 0.638 IN

E-W STIFFNESS OF THE
HIGH ROOF = $K_{HR} = \frac{(554^k)(0.496g)}{0.638 \text{ IN}}$
= 430^k/IN

WEIGHT TOTAL = 340^k + 554^k
= 894^k

$K_{TOT} = 247 + 430$
= 677^k/IN

DETERMINE STIFFNESS CHANGE DUE TO
MODIFICATION
(REFER TO THE STRESS MODEL AND
OUTPUT)

ORIGINAL DESIGN

APPLIED LOAD = 10^k @ NODE 4
DISPLACEMENT = 0.070 IN

$K_{ORIG} = 10^k / 0.070 \text{ IN} = 143^k/\text{IN}$

ENG. DEPT.	STATION: GINNA	DATE: 12/29/88	PAGE 12 OF
JOB: STRUCTURAL UPGRADE EWR 3296		MADE BY: LAS	CK:

REVISED DESIGN

APPLIED LOAD = 10 K @ NODE 4
DISPLACEMENT = 0.037 IN

$$K_{REV} = 10^K / 0.037 IN = 270^K / IN$$

$$STIFFNESS CHANGE = 270 - 143 = 127^K / IN$$

ESTIMATE THE INFLUENCE ON
THE AUX. BLDG FUNDAMENTAL
FREQUENCY

$$f = \frac{1}{2\pi} \sqrt{K/M}$$

$$f_{ORIG} = \frac{1}{2\pi} \sqrt{\frac{677}{894/g}} = 2.77 \text{ CPS}$$

$$f_{REV} = \frac{1}{2\pi} \sqrt{\frac{(677+127)}{(894+1)/g}} = 2.96 \text{ CPS}$$

$$\% \text{ CHANGE} = \frac{2.96 - 2.77}{2.77} \times 100\% = 7\%$$

THIS SMALL CHANGE IN FREQUENCY
IS CONSIDERED NOT SIGNIFICANT
BECAUSE IT IS WELL WITHIN THE



ENG. DEPT.	STATION: <i>GINNA</i>	DATE: <i>12/21/28</i>	PAGE <i>13</i> OF
JOB: <i>STRUCTURAL UPGRADE EWR 3296</i>		MADE BY: <i>LAS</i>	CK:

*BROAD BANDING GUIDELINE FOR
RESPONSE SPECTRA ($\pm 15\%$) SET
FORTH IN USNRC REGULATORY GUIDES,
AND WELL WITHIN FACTORS OF
SAFETY INHERENT IN ANY STRUCTURAL
OR COMPONENT DESIGN.*

