CYCLONE STRUCTURAL TESTING STATION
JAMES COOK UNIVERSITY

WIND LOADS ON A TYPICAL LOW-RISE HOUSE

by

J. D. Ginger, G. F. Reardon and B. J. Whitbread

TECHNICAL REPORT No 46

February 1998

CYCLONE STRUCTURAL TESTING STATION

WIND LOADS ON A TYPICAL LOW-RISE HOUSE

J. D. Ginger, G. F. Reardon and B. J Whitbread

Abstract

A wind tunnel model study was carried out to determine the wind loads on a typical low-rise house. The measured loads were satisfactorily enveloped by the pressure coefficients prescribed in AS1170.2 on most areas of the building except in the region immediately downwind of the ridge for oblique approach winds. The underestimation of pressure at the ridge for oblique approach winds by AS1170.2 can be avoided by increasing the local pressure factors K_L. The roof truss experiencing the largest wind load was identified as the second from the windward gable end. Selected load effects (ie. hold down forces etc.) determined using the covariance integration method were generally smaller than the design values obtained from using pressure coefficients prescribed in AS1170.2. The full scale testing procedure employed at the CSTS, by applying pressures from AS1170.2 generated larger load effects compared with those derived from wind tunnel data. The equivalent static pressure distributions obtained for selected load effects on the truss experiencing the largest wind loads were contained within the peak pressures derived from AS1170.2.

WIND LOADS ON A TYPICAL LOW-RISE HOUSE

TABLE OF CONTENTS

1 INTRODUCTION

Velocity fluctuations in the approach wind flow and flow around a building generate a spatially and temporally varying pressure field on the surface. The resulting wind load effects such as truss hold down forces, member axial forces etc. are therefore fluctuating in nature and difficult to predict even for a "static" structure such as a low-rise building.

Many wind loading codes including the Australian Wind Load Standard AS1170.2 (1989), use the quasi-steady method for designing low-rise buildings. Design peak loads on cladding elements and fixtures are determined in AS1170.2 by multiplying a local pressure coefficient with the design gust wind pressure. Load effects are obtained by applying peak (maximum and minimum) pressures on the tributary area of the building being supported by the structural component. Applying peak positive (and peak negative) pressures as specified in AS1170.2 results in errors when calculating these load effects, as the effects of spatial and temporal variations in the fluctuating wind loads over a tributary area are not adequately accounted for, even though pressure coefficients of alternative sign are sometimes given. The sign of this error depends on whether the sign of the influence coefficient for the load effect over the whole tributary area is the same or not, and also whether the positive or negative peak pressure is used. In a situation where the influence line has the same sign, local peak pressures taken in the same direction will be conservative, due to the fact that the peaks do not occur at the same instance (ie. pressure fluctuations are not fully correlated over the whole tributary area).

Holmes and Best (1981) and Ginger and Letchford (1991) have shown that significant reductions in some load effects may be achieved by accounting for the lack of correlation between the fluctuating pressures on tributary areas. However, there is also a possibility that AS1170.2 may underestimate the load effect in situations where the influence coefficients change sign over the tributary area of interest. These problems can be overcome in a wind tunnel study as shown by Holmes (1988a) by simultaneously measuring the pressures and combining them with the influence coefficients, on line. However, this process is cumbersome and beyond the capabilities of most wind tunnel test facilities. The *covariance integration* method developed by Holmes and Best (1981) could be used instead to conveniently determine the peak (ie. design) load effects. Kasperski and Niemann (1989) developed the *load-response-correlation* method which could be used to determine the equivalent static load distributions on a tributary area. This method has been refined and developed further by Kasperski (1990) and Holmes (1992).

New materials and innovative building techniques which satisfy the design loads derived either from AS1170.2 or from wind tunnel tests are currently used in the construction industry. Steel is increasingly utilized in structural components on roofs (ie. battens, trusses) and walls (ie. studs) in domestic construction. There is hence a need to evaluate design data and techniques used in the construction industry. Preliminary work relating to this study was carried out by Whitbread (1997) for an undergraduate thesis project. The full scale Nu-Steel house studied in this report was tested at the CSTS at JCU and reported by Reardon (1990). This wind tunnel study was carried out on a typical low-rise building model to:

- determine area averaged panel pressure coefficients on the wall and roof tributaries
- compare these pressure coefficients with values prescribed in AS1170.2
- identify the tributary areas (ie. roof trusses) which experience large loads
- calculate selected load effects using AS1170.2 data and wind tunnel test data

- determine equivalent static load distributions and compare with AS1170.2 data
- evaluate full-scale testing procedure carried out at the CSTS

The definitions and theory used in this report are described in Section 2. Section 3 describes the full-scale Nu-Steel house and tests carried out by the CSTS. The wind tunnel test procedure and model set-up are presented in Section 4. The pressure coefficients obtained in the wind tunnel study and comparisons with AS1170.2 are given in Section 5. In Section 6, selected load effects are calculated from wind tunnel test data using the Covariance Integration method and compared with values derived from AS1170.2. Eigenvector analysis is carried out and equivalent load distributions are also obtained. The full-scale testing procedure carried out at the CSTS is evaluated in Section 7. The conclusions and recommendations are made in Section 8.

2 THEORY

The pressure at a point (or panel) i $p_i(t)$, may be described in terms of the mean pressure averaged over time t $\bar{p}_i$,and the fluctuating component $p'(t)$ as in Eqn. 2.1.

$$p_i(t) = \bar{p}_i + p'(t) \tag{2.1}$$

The mean, standard deviation, maximum and minimum pressure coefficients are defined as

$$C_{\bar{p}} = \frac{\bar{p}-p_0}{\frac{1}{2}\rho\bar{U}^2},\quad C_{\sigma p} = \frac{\sigma_p}{\frac{1}{2}\rho\bar{U}^2},\quad C_{\hat{p}} = \frac{\hat{p}-p_0}{\frac{1}{2}\rho\bar{U}^2},\quad C_{\breve{p}} = \frac{\breve{p}-p_0}{\frac{1}{2}\rho\bar{U}^2}$$

where,	$\bar{p}, \sigma_p, \hat{p}, \breve{p}$	Mean, standard deviation, maximum and minimum pressure
	p_0	Reference pressure
	ρ	Density of air
	$\bar{U}$	Mean wind speed at roof (ie. eaves or ridge) height

2.1 Eigenvector Analysis

The statistical relationship between the magnitudes of the pressure fluctuations at i, and pressure fluctuations at j, at zero time lag is given by the covariance c_{ij};

$$c_{ij} = \overline{p_i'(t).p_j'(t)} \tag{2.2}$$

The correlation coefficient r_{ij} between the pressure at i and the pressure at j is then given by

$$r_{ij} = (\overline{p_i'(t).p_j'(t)}) \big/ (\sigma_{pi}.\sigma_{pj}) \tag{2.3}$$

Armitt (1968), showed that the spatially and temporally varying pressure $p_i(t)$ on a bluff body could be represented by a set of uncorrelated, orthogonal, normalized (ie. orthonormal) modes as in Eqn. 2.4, where the mode shapes e_{in} are the eigenvectors and $\overline{a_n(t)^2}$ are the eigenvalues of the covariance matrix [c]. The number of eigenvectors and eigenvalues is equal to the order of the covariance matrix which also equals the number of panel areas (or points) N on the tributary area under consideration.

$$p_i'(t) = \sum_{n=1}^{N} e_{in}.a_n(t) \qquad 2.4$$

For orthonormal set of modes that are uncorrelated

$$\{e_{1n},\ e_{2n},\ \ldots\ e_{Nn}\}\begin{Bmatrix} e_{1m} \\ e_{2m} \\ \\ e_{Nm} \end{Bmatrix} = 1 \quad \text{for } n = m \qquad 2.5$$

$$= 0 \quad \text{for } n \neq m$$

and $\overline{a_n(t).a_m(t)} = \overline{a_n(t)^2}$ for $n = m$ 2.6

$= 0$ for $n \neq m$

also $$\sum_{i=1}^{N} \overline{p'_i(t)^2} = \sum_{n=1}^{N} \overline{a_n(t)^2} \qquad 2.7$$

Eqn 2.7 shows that the variance of the pressure integrated over the tributary area is equal to the sum of eigenvalues, from which the relative contribution to the fluctuating pressure energy from each mode may be determined. As the eigenvector modes are the only uncorrelated modes from all the possible orthogonal modes of the covariance matrix, each eigenvector mode defines a separate flow mechanism. Best and Holmes (1983) and Holmes (1988b) showed that there is a strong connection between the first few modes (ie. those contributing most to the fluctuating pressure energy) and flow mechanisms. However due to the finite number of panels N analyzed, the latter modes usually do not relate to any well defined flow mechanism.

2.2 Covariance Integration Method

Selected load effects (ie. bending moments, axial forces), on structural components (trusses, battens) may be determined using the covariance integration method as shown by Holmes and Best (1981) and by Ginger and Letchford (1991). The load effect $\eta(t)$ resulting from wind loads acting on a tributary area, which is divided into N panel areas is given by Eqn. 2.8. The peak value of the load effect $\hat{\eta}$ will be determined from Eqn. 2.9, where $\overline{\eta}$ is the mean value, σ_η is the standard deviation and g_η is the peak factor of η. A typical value of 4.0 is generally used for g_η in most cases.

$$\eta(t) = \sum_{i=1}^{N} \beta_i p_i(t) A_i \qquad 2.8$$

$$\hat{\eta} = \overline{\eta} + g_\eta \sigma_\eta \qquad 2.9$$

$$\overline{\eta} = \sum_{i=1}^{N} \beta_i \overline{p}_i A_i \qquad 2.10$$

$$g_\eta = \frac{\left(\{\beta\}^T [A][C_{\sigma P}][g_P][r][g_P][C_{\sigma P}][A]\{\beta\}\right)^{1/2}}{\left(\{\beta\}^T [A][C_{\sigma P}][r][C_{\sigma P}][A]\{\beta\}\right)^{1/2}} \qquad 2.11$$

$$\sigma_\eta = \left[\tfrac{1}{2}\rho \overline{U}^2\right]\left[\{\beta\}^T [A][C_{\sigma p}][r][C_{\sigma p}][A]\{\beta\}\right]^{1/2} \qquad 2.12$$

where

$\{\beta\}$	N × 1 Vector of Influence Coefficients
[A]	N × N Diagonal Matrix of Panel Areas
$[C_{\sigma p}]$	N × N Diagonal Matrix of Standard Deviation Pressure Coefficients
$[r]$	N × N Diagonal Matrix of Pressure Correlation Coefficients
N	Number of Panel Areas
$[g_p]$	N × N Diagonal Matrix of Panel Area Averaged Pressure Peak Factors

Best and Holmes (1983) showed that the computation involved in the covariance integration method can be reduced by incorporating the following eigenvalue analysis.

$$\sigma_\eta = \left[\tfrac{1}{2}\rho \overline{U}^2\right]\left[\{\beta\}^T [F]]\{\beta\}\right]^{1/2} \qquad 2.13$$

where [F] is defined as the force coefficient covariance matrix. The eigenvalues of [F] in descending order of magnitude are (λ_1, λ_2, λ_3,........ λ_N) and the corresponding eigenvectors are [E] = ($\{e_1\}$, $\{e_2\}$, $\{e_3\}$,......$\{e_N\}$), normalized so that $\{e_n\}^T.\{e_n\} = 1$ as in Eqn. 2.5. A vector $\{\alpha\}$, $(\{\alpha\}^T = (\alpha_1, \alpha_2 .... \alpha_N)$ is defined such that $\{\beta\} = [E]\{\alpha\}$

Therefore $\{\alpha\} = [E]^{-1}\{\beta\} = [E]^T\{\beta\}$, and substituting into Eqn. 2.13 yields

$$\sigma_\eta = \left[\tfrac{1}{2}\rho \overline{U}^2\right]\left[\{\alpha\}^T [E]^T [F][E]\{\alpha\}\right]^{1/2} \qquad 2.14$$

$$\sigma_\eta = \left[\tfrac{1}{2}\rho \overline{U}^2\right]\left[\{\alpha\}^T [\lambda]\{\alpha\}\right]^{1/2} \qquad 2.15$$

$$\sigma_\eta = \left[0.5\rho \overline{U}^2\right]\left[(\alpha_1^2\lambda_1 + \alpha_2^2\lambda_2 + ... + \alpha_n^2\lambda_n\right]^{1/2} \qquad 2.16$$

Now if the eigenvalues beyond the mth eigenvalue are small, their influence may be ignored and;

$$\sigma_\eta = \left[\tfrac{1}{2}\rho \overline{U}^2\right]\left[(\alpha_1^2\lambda_1 + \alpha_2^2\lambda_2 + ... + \alpha_m^2\lambda_m\right]^{1/2} \qquad 2.17$$

2.3 Equivalent Static Load Distribution

Kasperski and Niemann (1989) derived an expression for the peak load at j, P_j which produces the peak value of load effect η in Eqn. 2.18

$$(P_j)_{\hat{\eta}} = \overline{P_j} + g_\eta r_{P_j\eta}\sigma_{P_j} \qquad 2.18$$

where $r_{pj,\eta}$ is the correlation coefficient between the wind load fluctuations at j and the load effect η.

$$r_{P_j\eta} = \overline{P_j'(t)\eta'(t)} / (\sigma_{P_j}.\sigma_\eta) \qquad 2.19$$

Following on from Holmes (1992), the fluctuating load effect can be written as

$$\eta'(t) = \sum_{i=1}^{N} P_i'(t)\beta_i \qquad 2.20$$

and $r_{P_j\eta} = \sum_{i=1}^{N} \overline{P_i'(t).P_j'(t)}\beta_i / \left(\sigma_{P_j}.\sigma_\eta\right)$ 2.21

Substituting eigenvector expansions $P_i'(t) = \sum_{n=1}^{N} e_{in}.a_n(t)$ and $P_j'(t) = \sum_{k=1}^{N} e_{jk}.a_k(t)$ into Eqn. 2.21

$$r_{P_j\eta} = \sum_{i=1}^{N}\left[\overline{\sum_{n=1}^{N} e_{in}.a_n(t) \sum_{k=1}^{N} e_{jk}.a_k(t)}\right]\beta_i / \left(\sigma_{P_j}.\sigma_\eta\right) \qquad 2.22$$

$$r_{P_j\eta} = \left\{\sum_{n=1}^{N}\left[\sum_{i=1}^{N} e_{in}\beta_i\right]\overline{a_n(t)\sum_{k=1}^{N} e_{jk}.a_k(t)}\right\} / \left(\sigma_{P_j}.\sigma_\eta\right) \qquad 2.23$$

Noting that $\overline{a_n(t)a_k(t)} = 0$ for n $\neq$ k and $\overline{a_n^2(t)} = \lambda_n$

$$\alpha_n = \sum_{i=1}^{N} e_{in}\beta_i \qquad \text{and} \qquad \sigma_\eta = \left[\sum_{n=1}^{N}\alpha_n^2\lambda_n\right]^{1/2}$$

Hence Eqn. 2.23 becomes $r_{P_j\eta}.\sigma_{P_j} = \left[\sum_{n=1}^{N}\alpha_n e_{jn}\lambda_n\right] \Big/ \left[\sum_{n=1}^{N}\alpha_n^2\lambda_n\right]^{1/2}$ 2.24

Eqn. 2.24 together with Eqn. 2.18 can be used to determine the equivalent static peak load distribution. The advantage of this formulation is that the summations in Eqn 2.24 can be truncated after three or four modes, as the contributions rapidly reduce as the mode number n increases.

3 THE NU-STEEL KIT HOME

The full scale Nu-Steel Kit Home of the "Matilda" plan constructed and tested at the CSTS, JCU is typical of steel framed house construction with typical wall and roof framing members. It is 7.5m wide (b) × 15.6m long (d) × 2.45m eaves height (h) and has a roof pitch of 20°, as shown in Figure 3.1. The trusses were spaced 1.2 m apart. Full details of the house and tests carried out are given in Reardon(1990). A brief description of the various components follow.

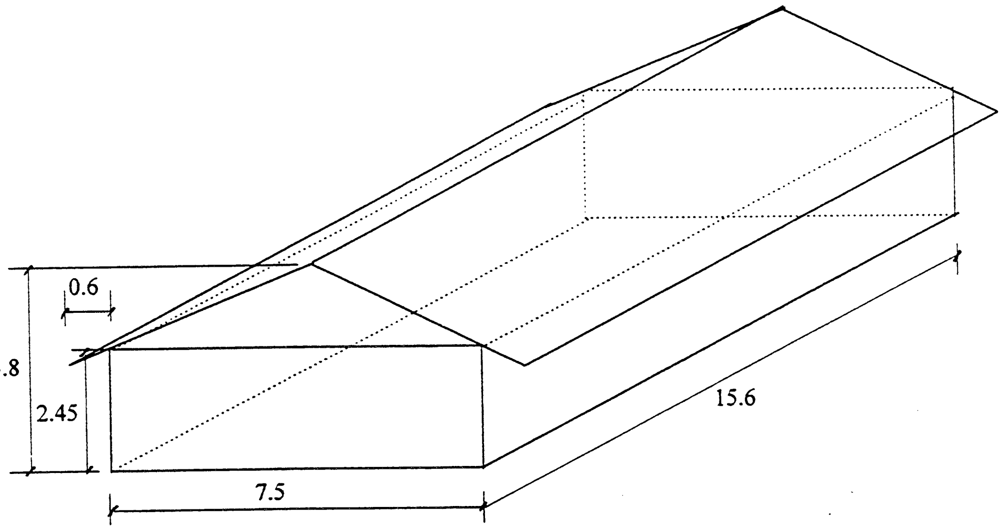


Figure 3.1 The Full-Scale 7.5 x 15.6 x 3.8 m "Matilda" Nu-Steel House Tested at the CSTS

Wall Frames The external wall frames were 2450 mm high with studs at 600 mm spacing. The channel section components were made to fit snugly into each other. The 75 × 32 × 1.2 mm studs fitted into the 78 × 31 × 1.2 mm bottom plate and the 72 × 34 × 1.2 mm noggings fitted into the studs at approximately mid height. The top plate on the load bearing external walls was 79 × 75 × 1.6 mm stiffened plate section, whereas that on the non load-bearing walls was the same section as the bottom plate.

Roof Trusses The roof trusses were conventional W-braced trusses spanning 7500 mm with 20° pitch. They had a 600 mm overhang and were spaced 1200 mm apart. The top and bottom chord members were 101 × 47 × 1.0 Z-sections, while the braces were 75 × 32 × 1.2 mm channel members. All joints were welded. At the heel joint of the truss, the top leg of the bottom chord had been cut back to fabricate the joint. This joint was then reinforced with a 100 × 75 × 6 mm U shaped bracket welded in position. The bracket had a leg that extended approximately 300 mm along the bottom chord.

Battens The roof battens were 0.75 mm thick LBI "top hat" section. Five battens were used on each slope resulting in end spacings of 900 mm and internal spacing of 1310 mm. The battens were fixed to the top chords of the trusses with four 14 × 22 mm self drilling screws per crossover. The light gauge steel ceiling battens were of a similar shape to the roof battens but were made from thinner material, 0.47 mm thick. The ceiling battens were spaced 450 mm apart and were fixed with two 10 × 16 mm self drilling screws per crossover.

Cladding The roofing was LBI Trimdek fixed to the battens with one 14 × 50 mm screw per rib. The screws were the coarse threaded Type 17 variety, which was developed for fixing to timber. The external wall cladding was 6 mm Hardiplank fixed to the studs with one 8 × 35 mm screw per crossover. Most of the internal wall lining was 10 mm plasterboard fixed in accordance with manufacturers specification. The ceiling lining was 10 mm plasterboard

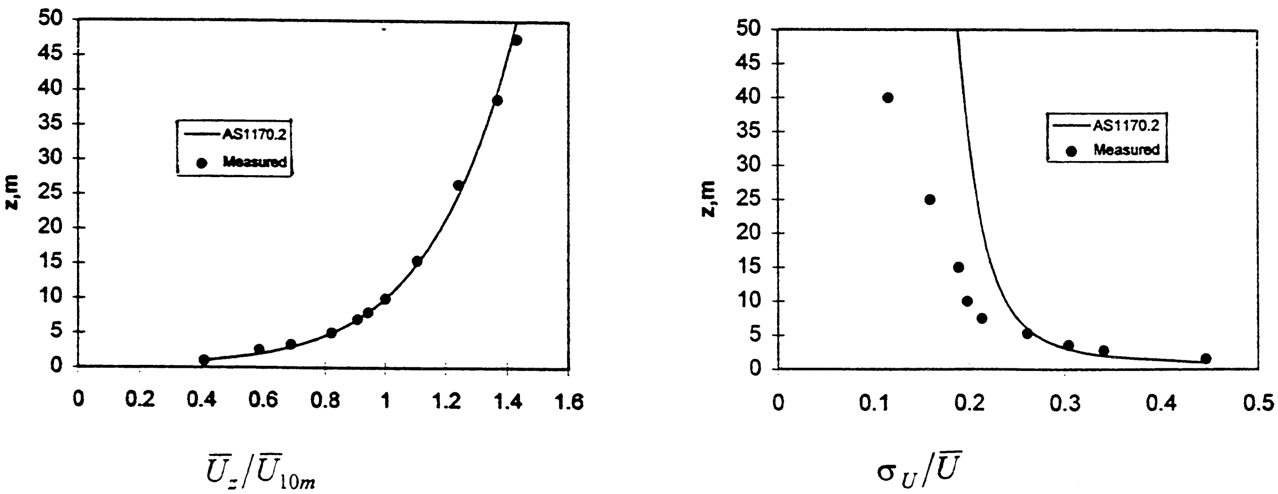
The full scale tests at the CSTS were carried out for the basic 10m height design wind velocity of 63.25 m/s (ie. cyclone area). As the house was designed for terrain category 3 as per AS1170.2 (1983), the equivalent permissible stress design wind speed was 42m/s at a height of 6m.

The full scale tests were simulated for approach winds perpendicular to and parallel to the ridge. Flying debris generated in wind storms are shown to regularly damage the envelope on the windward face. A dominant windward opening on an otherwise nominally sealed building will transmit the external pressure to the inside of the building. This results in increased net upward loads on the roof of the building. The full scale tests were carried out in two stages. In the first stage, cyclic loads were applied to the roof and wall according to specifications in EBS Technical Record TR440(1983), and in the second stage static loads were applied in step increments. At each increment, horizontal and vertical displacements at selected locations of the house were measured.

4 EXPERIMENTAL TEST SET UP

4.1 Atmospheric Boundary Layer (ABL) Simulation

The wind tunnel tests were carried out in the 2.0 m high × 2.5 m wide × 17.5 m long Boundary Layer Wind Tunnel at the Department of Civil & Environmental Engineering at JCU. The approach ABL was simulated at a length scale, L_r of 1/50 for terrain category 3 (as per AS1170.2) using a fence at the upstream end followed by roughness blocks installed on the floor. The ABL was satisfactorily modeled as shown by the simulated mean velocity, referenced to the mean velocity at 10m elevation and turbulence intensity profiles plotted against terrain category 3 profiles in Figure 4.1. The longitudinal velocity spectrum indicated that the scale of turbulence was about 3 times smaller than the target value. This was shown by Stathopoulos and Surry (1983) to be an acceptable level of relaxation for these types of wind tunnel studies.



(a) Mean Velocity Profile

(b) Turbulence Intensity Profile

Figure 4.1 Wind Tunnel Simulation of the Atmospheric Boundary Layer at L_r = 1/50 and Terrain Category 3 as per AS1170.2

The "Nu-Steel" building shown in Figure 4.2 was constructed from perspex at a length scale, L_r of 1/50. The 1.2m wide roof truss tributaries in full scale were identified as A,B,C,..N. Each roof truss tributary was divided into panels centered at batten truss connections and identified as 1,2,3,..12. The leeward wall and windward wall areas were identified as W1,W2, and W3, W4 respectively.

External pressures were obtained on the roof and walls for approach wind directions(θ) of 0° to 90° at intervals of 15°. Pressure taps on each panel area were manifolded with 1.5 mm diameter PVC tubes and restrictor and connected to Honeywell pressure transducers via Scanivalves. The pressure measurement system had a good frequency response up to the signal low-pass filter frequency of 200 Hz. The data was sampled at 500 Hz for 30 secs for a single run and the results were obtained from averaging five(5) separate runs. This data also provides the pressure distribution on the tributary area of each roof truss. The mean and peak pressure distributions were used to identify the trusses experiencing large wind loads. The mean pressure distribution was used for comparisons with data prescribed in AS1170.2.

The correlation of pressures between each panel area on selected tributaries (ie. roof trusses experiencing the largest wind loads) were measured using a DATA6000 Signal Analyzer. The pressure signals from panels i and j were input to the Signal Analyzer, sampled at 500 Hz for 32 secs and the correlation coefficient of the two signals was obtained.

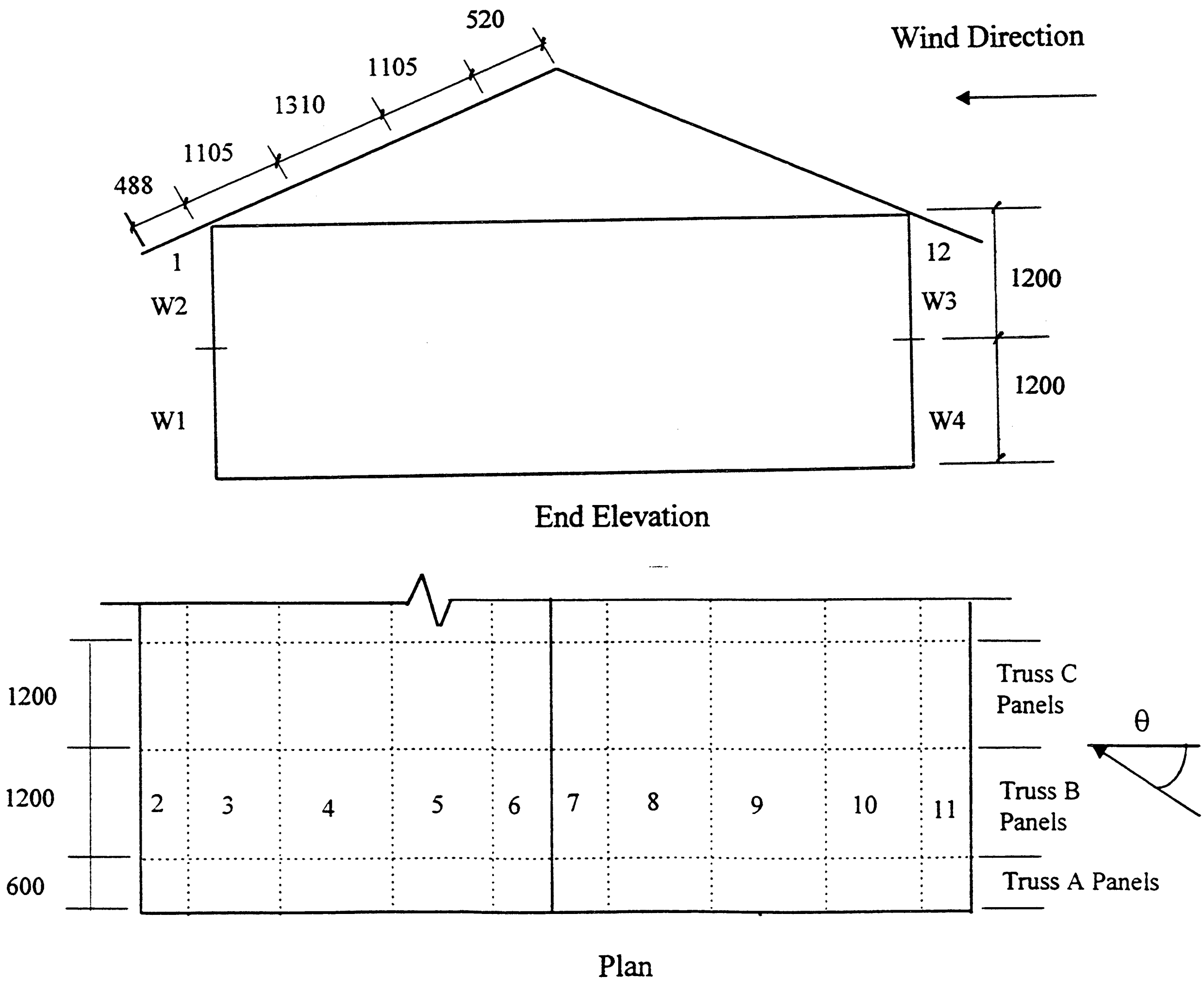


Figure 4.2 Nu-Steel Building Roof and Wall Panel Areas All dimensions in mm

5 PRESSURE DISTRIBUTION

The variation of mean, standard deviation, maximum and minimum area averaged panel pressure coefficients with wind direction θ, over the wall and roof trusses A..N, are given in Table A1 to Table A7 in Appendix A. Truss B (ie. 2nd truss from the windward gable end) was identified as the truss which is subjected to the largest wind loads. The mean, maximum and minimum pressure coefficients measured for $\theta = 0^\circ$, 45° and 90° on truss B, in the wind tunnel are compared with corresponding values given in AS1170.2, in Figures 5.1, 5.2 and 5.3 respectively. AS1170.2 prescribes a local pressure factor K_L of 1.5 and 2.0 to be applied with negative pressures on areas of extent less than $1.0a^2$ and $0.25a^2$ within a distance of 1.0a and 0.5a respectively from edge discontinuities, where the dimension 'a' is taken to be the minimum of 0.2b or 0.2d or h. The appropriate local pressure factor K_L is included in this analysis, with a = 1.5m.

Tables A1(a) to A1(d) in Appendix A, show that for $\theta = 0^\circ$ (ie. wind perpendicular to ridge), the windward wall and the underside of the windward roof overhang experience mean positive pressures while the rest of the roof and leeward wall experience mean suction pressures. The largest suction pressures were measured at the ridge as a result of flow separation. Figure 5.1 shows that the alternative pressure coefficients (including the K_L factor) given in AS1170.2 and denoted as distribution 1 and distribution 2, satisfactorily encompasses the measured mean values.

Tables A7(a) to A7(d) in Appendix A, show that for $\theta = 90^\circ$ (ie. wind flow parallel to ridge), the side-wall near the windward gable end and the underside of the roof overhang experiences mean suction pressures while the roof experiences large mean suction pressures near the gable end (from truss A to truss C). The pressure then drops off sharply towards the downstream end of the roof. Figure 5.3 shows that the alternative pressure coefficients (including the K_L factor) given in AS1170.2 are large compared with the measured mean values. The pressure coefficients given in AS1170.2 could therefore be reduced from -0.9 to -0.8 for a distance up to 0.5h from the windward edge and from -0.9 to -0.7 for a distance from 0.5h from to 1.0h from the windward edge. The magnitude of local peak pressure derived from AS1170.2 should be retained by increasing the local pressure factor K_L from 1.5 to 2.0 and 2.0 to 2.5.

Tables A2, A3 and A4 show that for approach wind directions θ between 15° and 45°, large mean suction pressures were measured on the leeward half of the roof close to the windward gable end (ie. trusses A to B) and along the ridge, and mean positive pressures on the windward wall and windward half of the roof. As shown in Figure 5.2, measured mean pressures adjacent to the ridge were generally larger than the pressure coefficients given in AS1170.2 (including the K_L factor) for $\theta = 0^\circ$. This underestimation in AS1170.2 can be avoided by increasing the magnitude of the local pressure factors K_L from 1.5 to 2.0 and from 2.0 to 2.5. Tables A5 and A6 show that as θ was changed between 60° to 75°, the pressure distribution changed to larger suction pressures close to the windward gable end (ie. truss A, B) and smaller positive pressures on the wall.

Ginger and Letchford (1995) found that the local pressure factors K_L provided in AS1170.2 tended to underestimate peak pressures on small areas especially for oblique wind approach directions. Cochran and Cermak (1992) showed that local peak suctions measured on a wind tunnel model were smaller than those measured on the full scale Texas Tech building. Ginger and Letchford (1997) showed that peak net pressures measured on small areas near the windward roof edge, on the full scale Texas Tech building with a dominant windward opening was larger than that obtained from AS1170.2. The local pressure factors given in AS1170.2 are mainly based on wind tunnel studies and therefore can provide unconservative peak pressures.

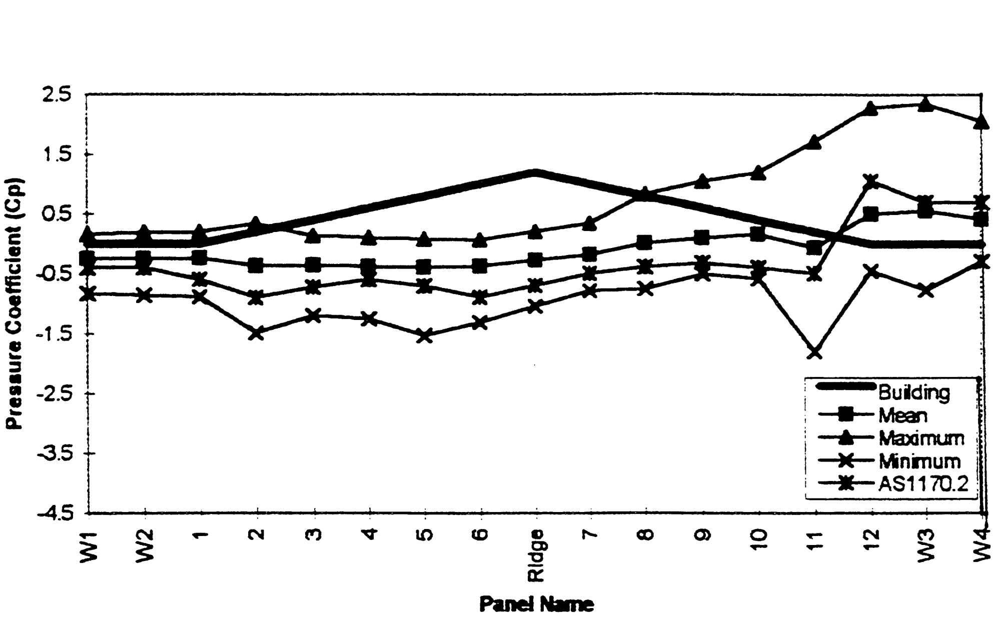


Figure 5.1(a) Mean, Maximum and Minimum Pressure Coefficients Measured on Truss B, θ = 0° AS1170.2 (1989) Pressure Coefficients, θ = 0° Distribution 1

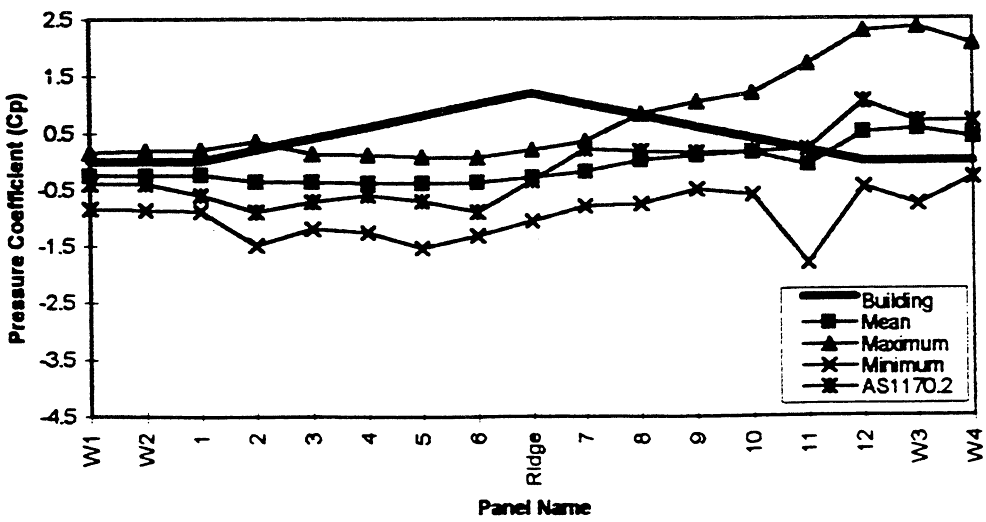


Figure 5.1(b) Mean, Maximum and Minimum Pressure Coefficients Measured on Truss B, θ = 0° AS1170.2 (1989) Pressure Coefficients, θ = 0° Distribution 2

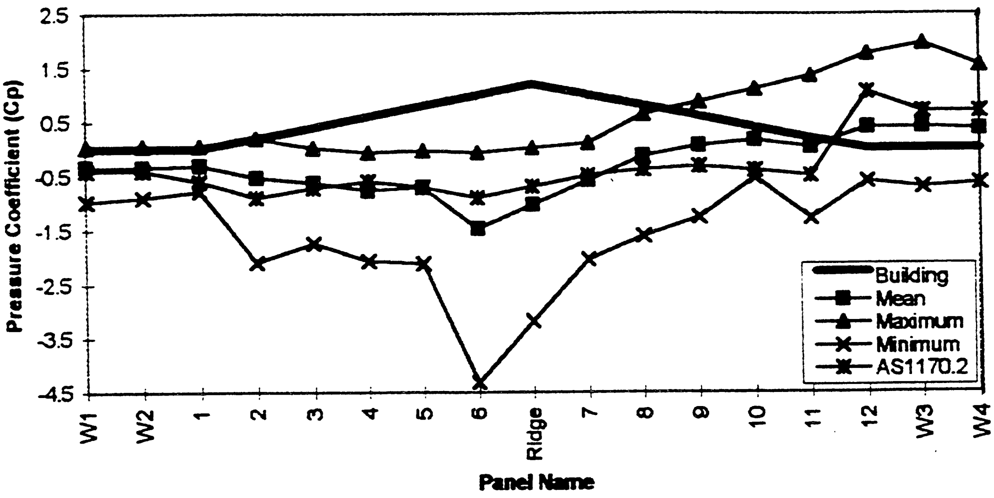


Figure 5.2(a) Mean, Maximum and Minimum Pressure Coefficients Measured on Truss B, θ = 45°
AS1170.2 (1989) Pressure Coefficients, θ = 0° Distribution 1

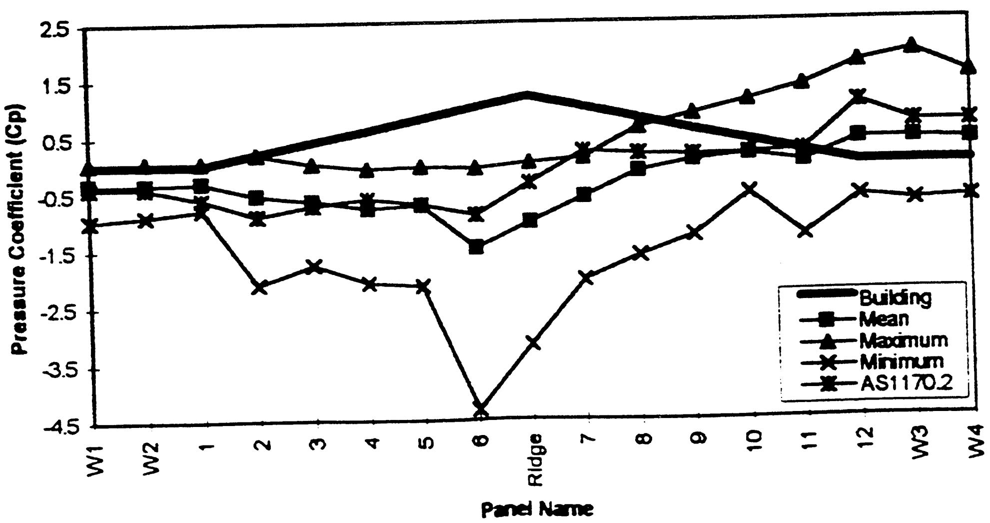


Figure 5.2(b) Mean, Maximum and Minimum Pressure Coefficients Measured on Truss B, θ = 45°
AS1170.2 (1989) Pressure Coefficients, θ = 0° Distribution 2

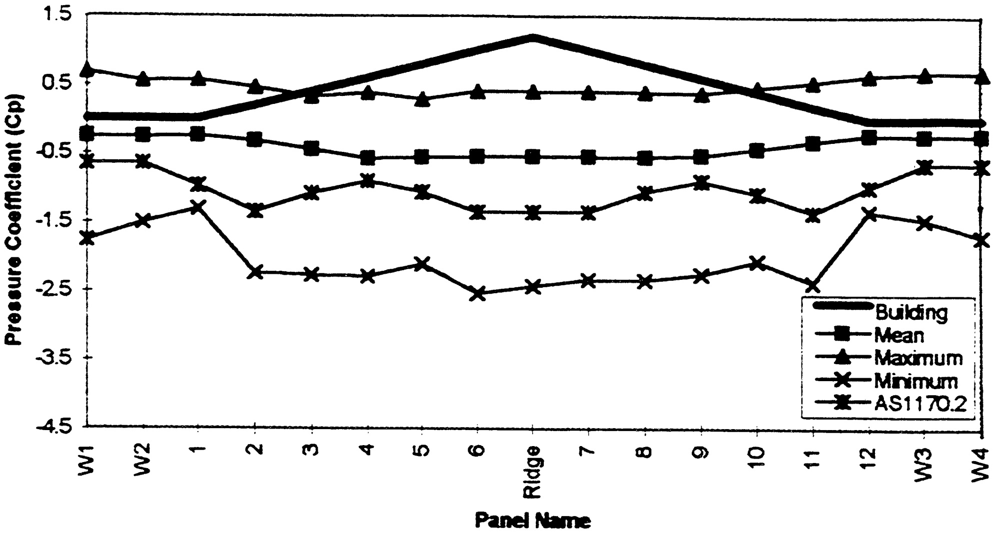


Figure 5.3(a) Mean, Maximum and Minimum Pressure Coefficients Measured on Truss B, θ = 90°
AS1170.2 (1989) Pressure Coefficients, θ = 90° Distribution 1

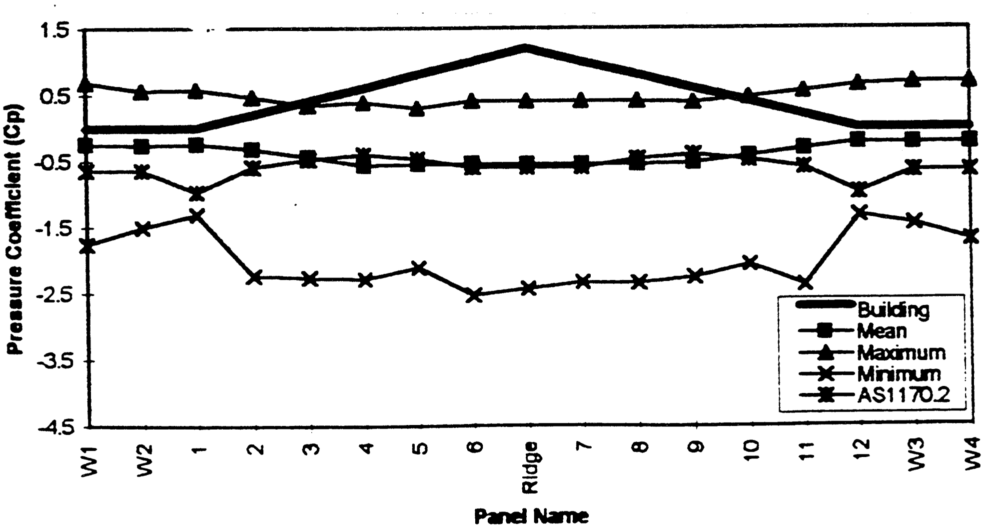


Figure 5.3(b) Mean, Maximum and Minimum Pressure Coefficients Measured on Truss B, θ = 90°
AS1170.2 (1989) Pressure Coefficients, θ = 90° Distribution 2

5.1 Variability of Pressure Data

The percentage variability of the measured pressures are defined in terms of the standard deviation of all the data set divided by the mean. The variability of mean and peak pressure coefficients at selected panels on truss B are given in Table 5.1.

Table 5.1 Variability of Mean and Peak Pressure Coefficients on selected panels on truss B

Panel Number	θ, deg	Variability, %	
		Mean C_p	Peak C_p
6	45	1.2	7.1
3	30	1.1	8.0
W1	90	3.2	3.6
W3	0	1.9	4.9

6 LOAD EFFECTS, EIGENVALUES AND LOAD DISTRIBUTION

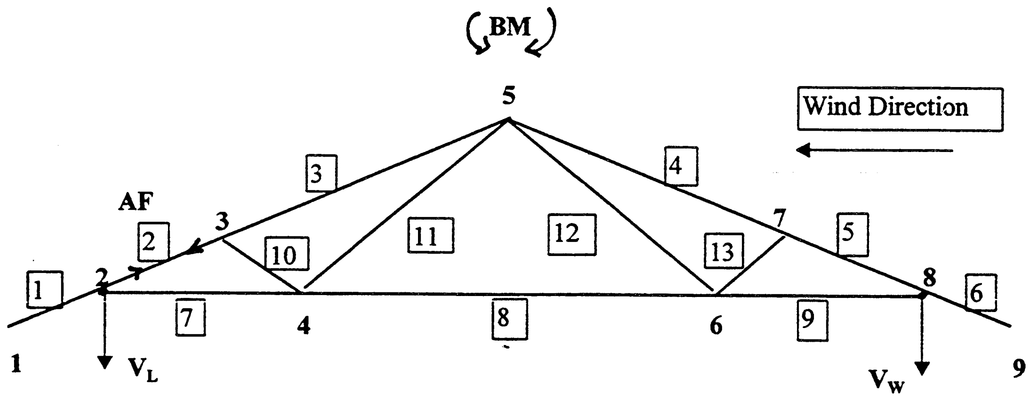
Truss B was identified in Section 5, as the truss that experiences the largest wind load effects and was selected for further analysis and design. The extent of the areas of roof panels 1 to 12 on the truss are given in Table 6.1. The structural system and the joints and connections and the member numbers are shown in Figure 6.1. The influence coefficients for windward and leeward hold down forces, axial force on member # 2 and ridge bending moment V_W, V_L, , $AF_{Mem\#2}$, and BM_{Ridge} respectively are given in Table 6.2. These were found by applying unit loads of 1N at the batten truss connections shown in Figure 6.1, in the structural analysis program SPACE GASS and given in Appendix B.

Table 6.1. Extent of Roof Panel Areas 1 to 12

Panel Number	Panel Area, (m^2)
1	0.77
2	0.63
3	1.33
4	1.57
5	1.33
6	0.71
7	0.71
8	1.33
9	1.57
10	1.33
11	0.63
12	0.77

Table 6.2 Influence Coefficients for Roof Truss Load Effects

Panel Number	Load Effect V_W	V_L	BM_{Ridge}	$AF_{Mem\#2}$
	N	N	Nmm	N
1	-0.08	1.02	19.10	-0.69
2	0.08	-1.02	-19.10	0.69
3	-0.04	-0.90	12.82	-0.39
4	-0.22	-0.72	27.99	-1.71
5	-0.39	-0.55	-155.57	-1.75
6	-0.51	-0.43	-68.09	-1.25
7	-0.43	-0.51	68.09	-1.46
8	-0.55	-0.39	-155.57	-1.09
9	-0.72	-0.22	27.99	-0.64
10	-0.90	-0.04	12.82	-0.13
11	-1.02	0.08	-19.10	0.21
12	1.02	-0.08	19.10	-0.21



Numbers in Boxes denote Member Nos. and **Bold Numbers** denote Joint Numbers

Figure 6.1 Truss Members, Joints and Load Effects

The pressure correlation coefficients measured between each panel area (1..12) on truss B for θ = 0°, 30°, and 90° are given in Tables 6.3 to 6.5. The standard deviation panel area pressure coefficients on truss B for θ = 0°, 30° and 90° are extracted from Tables A1(d), A3(d) and A7(d) and the panel pressure peak factors g_p calculated from Equation 2.11 are given in Table 6.6.

Table 6.3 Correlation Coefficient Matrix between Panels on Truss B $\theta = 0^o$

Panel #	1	2	3	4	5	6	7	8	9	10	11	12
1	1.00	0.96	0.96	0.96	0.96	0.97	0.90	0.61	0.28	0.01	0.52	-0.72
2	0.96	1.00	0.98	0.95	0.94	0.96	0.87	0.53	0.18	-0.12	0.45	-0.74
3	0.96	0.98	1.00	0.98	0.97	0.97	0.86	0.45	-0.06	-0.28	0.40	-0.79
4	0.96	0.95	0.98	1.00	0.98	0.98	0.82	0.18	-0.20	-0.37	0.35	-0.79
5	0.96	0.94	0.97	0.98	1.00	0.99	0.84	0.22	-0.24	-0.45	0.29	-0.81
6	0.97	0.96	0.97	0.98	0.99	1.00	0.84	0.30	-0.21	-0.41	0.31	-0.80
7	0.90	0.87	0.86	0.82	0.84	0.84	1.00	0.71	0.21	0.00	0.42	-0.49
8	0.61	0.53	0.45	0.18	0.22	0.30	0.71	1.00	0.84	0.68	0.49	0.21
9	0.28	0.18	-0.06	-0.20	-0.24	-0.21	0.21	0.84	1.00	0.89	0.64	0.19
10	0.01	-0.12	-0.28	-0.37	-0.45	-0.41	0.00	0.68	0.89	1.00	0.53	0.36
11	0.52	0.45	0.40	0.35	0.29	0.31	0.42	0.49	0.64	0.53	1.00	-0.48
12	-0.72	-0.74	-0.79	-0.79	-0.81	-0.80	-0.49	0.21	0.19	0.36	-0.48	1.00

Table 6.4 Correlation Coefficient Matrix between Panels on Truss B $\theta = 30^o$

Panel #	1	2	3	4	5	6	7	8	9	10	11	12
1	1.00	0.98	0.97	0.97	0.97	0.95	0.95	0.75	-0.06	-0.41	0.42	-0.87
2	0.98	1.00	0.99	0.98	0.97	0.96	0.95	0.67	-0.14	-0.48	0.30	-0.88
3	0.97	0.99	1.00	0.98	0.96	0.96	0.95	0.59	-0.37	-0.57	0.25	-0.88
4	0.97	0.98	0.98	1.00	0.97	0.95	0.94	0.46	-0.47	-0.65	0.20	-0.89
5	0.97	0.97	0.96	0.97	1.00	0.97	0.95	0.42	-0.55	-0.70	0.16	-0.92
6	0.95	0.96	0.96	0.95	0.97	1.00	0.97	0.46	-0.50	-0.70	0.09	-0.90
7	0.95	0.95	0.95	0.94	0.95	0.97	1.00	0.63	-0.35	-0.57	0.24	-0.84
8	0.75	0.67	0.59	0.46	0.42	0.46	0.63	1.00	0.48	0.27	0.61	-0.21
9	-0.06	-0.14	-0.37	-0.47	-0.55	-0.50	-0.35	0.48	1.00	0.88	0.62	0.27
10	-0.41	-0.48	-0.57	-0.65	-0.70	-0.70	-0.57	0.27	0.88	1.00	0.42	0.60
11	0.42	0.30	0.25	0.20	0.16	0.09	0.24	0.61	0.62	0.42	1.00	-0.33
12	-0.87	-0.88	-0.88	-0.89	-0.92	-0.90	-0.84	-0.21	0.27	0.60	-0.33	1.00

Table 6.5 Correlation Coefficient Matrix between Panels on Truss B $\theta = 90^o$

Panel #	1	2	3	4	5	6	7	8	9	10	11	12
1	1.00	0.86	0.90	0.87	0.86	0.86	0.82	0.82	0.84	0.82	0.76	0.79
2	0.86	1.00	0.91	0.87	0.86	0.85	0.82	0.82	0.83	0.79	0.75	0.77
3	0.90	0.91	1.00	0.95	0.93	0.91	0.89	0.89	0.88	0.87	0.81	0.82
4	0.87	0.87	0.95	1.00	0.97	0.95	0.92	0.92	0.91	0.90	0.85	0.87
5	0.86	0.86	0.93	0.97	1.00	0.98	0.95	0.94	0.92	0.90	0.85	0.86
6	0.86	0.85	0.91	0.95	0.98	1.00	0.97	0.95	0.93	0.89	0.83	0.83
7	0.82	0.82	0.89	0.92	0.95	0.97	1.00	0.98	0.94	0.92	0.84	0.85
8	0.82	0.82	0.89	0.92	0.94	0.95	0.98	1.00	0.97	0.92	0.85	0.86
9	0.84	0.83	0.88	0.91	0.92	0.93	0.94	0.97	1.00	0.95	0.87	0.87
10	0.82	0.79	0.87	0.90	0.90	0.89	0.92	0.92	0.95	1.00	0.92	0.90
11	0.76	0.75	0.81	0.85	0.85	0.83	0.84	0.85	0.87	0.92	1.00	0.88
12	0.79	0.77	0.82	0.87	0.86	0.83	0.85	0.86	0.87	0.90	0.88	1.00

Table 6.6 Roof Panel Pressure Peak Factors Truss B

Panel No.	Pressure Peak Factors, g		
	$\theta = 0^o$	$\theta = 30^o$	$\theta = 90^o$
1	5.13	5.53	5.48
2	6.96	5.52	7.76
3	5.97	5.65	7.22
4	6.01	5.77	6.07
5	7.87	5.43	5.56
6	6.53	5.65	6.72
7	5.04	6.58	6.02
8	5.59	5.97	6.32
9	5.84	5.63	6.15
10	5.27	5.71	6.32
11	4.83	5.48	8.00
12	5.76	6.92	5.98

The first three (ie. three largest) eigenvalues and corresponding eigenvectors of the force covariance coefficient matrix [F] measured between each panel area (1..12) along with the ratios of first three eigenvalues to total sum of eigenvalues on truss B for $\theta = 0^o$, 30^o and 90^o are given in Tables 6.7 to 6.9. These results indicate that more than 90% of the fluctuating pressure energy is from the first three modes. The first mode shape matches the mean pressure distribution shape and contains more than 50% (upto 87% for $\theta = 90^o$) of the fluctuating pressure energy.

Table 6.7. Eigenvalues and Eigenvectors of [F] $\theta = 0^o$

Mode	λ_j	Eigenvectors											
j		e_{1j}	e_{2j}	e_{3j}	e_{4j}	e_{5j}	e_{6j}	e_{7j}	e_{8j}	e_{9j}	e_{10j}	e_{11j}	e_{12j}
1	0.22	-0.18	0.19	-0.38	-0.47	-0.41	-0.21	-0.13	-0.01	0.17	0.29	-0.14	0.45
2	0.18	0.13	0.11	0.13	0.08	0.04	0.03	0.10	0.41	0.56	0.51	0.44	-0.04
3	0.04	-0.11	-0.11	-0.20	-0.13	-0.16	-0.10	-0.18	-0.52	0.00	0.10	0.53	-0.54
Percentage Fluctuating Energy in First Three Modes													99%

Table 6.8. Eigenvalues and Eigenvectors of [F] $\theta = 30^o$

Mode	λ_j	Eigenvectors											
j		e_{1j}	e_{2j}	e_{3j}	e_{4j}	e_{5j}	e_{6j}	e_{7j}	e_{8j}	e_{9j}	e_{10j}	e_{11j}	e_{12j}
1	0.59	-0.11	-0.15	-0.37	-0.51	-0.47	-0.44	-0.17	-0.11	0.16	0.22	-0.04	0.22
2	0.12	0.11	0.11	0.14	0.06	-0.02	-0.08	0.07	0.45	0.58	0.44	0.45	-0.05
3	0.02	0.02	0.05	0.13	-0.04	-0.08	0.17	0.12	0.55	-0.11	0.13	-0.54	-0.55
Percentage Fluctuating Energy in First Three Modes													98%

Table 6.9. Eigenvalues and Eigenvectors of [F] θ = 90°

Mode	λ_j	Eigenvectors											
j		e_{1j}	e_{2j}	e_{3j}	e_{4j}	e_{5j}	e_{6j}	e_{7j}	e_{8j}	e_{9j}	e_{10j}	e_{11j}	e_{12j}
1	1.00	-0.13	-0.14	-0.32	-0.43	-0.36	-0.20	-0.20	-0.37	-0.43	-0.33	-0.14	-0.13
2	0.03	0.14	0.19	0.45	0.44	0.24	0.07	-0.09	-0.28	-0.49	-0.37	-0.13	-0.07
3	0.02	-0.14	-0.08	-0.21	-0.08	0.26	0.27	0.26	0.46	0.06	-0.57	-0.35	-0.24
Percentage Fluctuating Energy in First Three Modes													92%

The mean load effects, load effect peak factors, standard deviation load effects and the resultant peak load effect derived from the covariance integration method (ie. Eqn 2.9) are given in Tables 6.10 to 6. 12 and compared with load effects derived from AS1170.2. The load effects in Tables 6.10 to 6.12 have been normalized by $0.5\rho\bar{U}^2$.

Table 6.10 Normalized Load Effects θ = 0°

Load Effect	Covariance Integration Method				AS 1170.2
	Mean η	g_η	σ_η	Peak η	Peak η
V_W (N/Pa)	0.68	5.52	0.78	4.97	10.54
V_L(N/Pa)	1.30	6.66	0.53	4.83	9.81
$AF_{Mem\ \#2}$(N/Pa)	2.39	6.35	1.07	9.18	19.42
BM_{Ridge}(Nm/Pa)	0.099	6.80	0.054	0.465	0.786

Table 6.11 Normalized Load Effects θ = 30°

Load Effect	Covariance Integration Method				AS 1170.2
	Mean η	g_η	σ_η	Peak η	Peak η
V_W(N/Pa)	1.40	5.92	0.75	5.81	10.54
V_L(N/Pa)	2.71	5.70	0.97	8.23	9.81
$AF_{Mem\ \#2}$(N/Pa)	5.47	5.71	1.98	16.77	19.42
BM_{Ridge}(Nm/Pa)	0.242	5.70	0.099	0.804	0.785

Table 6.12 Normalized Load Effects θ = 90°

Load Effect	Covariance Integration Method				AS 1170.2
	Mean η	g_η	σ_η	Peak η	Peak η
V_W(N/Pa)	2.41	6.41	1.27	10.57	16.97
V_L(N/Pa)	2.44	6.57	1.25	10.68	16.97
$AF_{Mem\ \#2}$(N/Pa)	2.78	6.01	5.47	22.15	36.06
BM_{Ridge}(Nm/Pa)	0.269	6.06	0.112	0.895	1.409

The equivalent static pressure distribution responsible for each peak load effect is given in Tables 6.13 to 6.15 along with the corresponding value obtained from AS1170.2. The values from AS1170.2 were obtained by multiplying the C_p by G_U^2 which for terrain category 3 at z = 4m is $(2.00)^2 = 4.0$. The results in Tables 6.13 to 6.15 show that AS1170.2 satisfactorily envelopes the equivalent static load pressures, except as expected, at the region near the ridge (ie. Panel # 6) for θ = 30°.

Table 6.13 Equivalent Static Load Distribution θ = 0°

Panel #	Equivalent Peak Pressure for Load Effect				AS1170.2
	V_W	V_L	BM_{ridge}	AF_{Mem2}	
1	-0.79	-1.09	-1.10	-1.07	-1.6
2	-1.00	-1.45	-1.43	-1.39	-2.4
3	-0.83	-1.29	-1.30	-1.22	-2.4
4	-0.78	-1.28	-1.22	-1.21	-2.4
5	-0.75	-1.29	-1.28	-1.22	-2.4
6	-0.76	-1.28	-1.29	-1.21	-2.4
7	-0.63	-0.94	-1.01	-0.93	-1.32,0.56
8	-0.57	-0.53	-0.62	-0.57	-1.32,0.56
9	-0.53	0.01	-0.13	-0.08	-1.32,0.56
10	-0.44	0.35	0.21	0.21	-1.32,0.56
11	-1.90	-1.13	-1.21	-1.17	-1.32,0.56
12	1.33	1.87	1.63	1.68	2.8

Table 6.14 Equivalent Static Load Distribution θ = 30°

Panel #	Equivalent Peak Pressure for Load Effect				AS1170.2
	V_W	V_L	BM_{ridge}	AF_{Mem2}	
1	-1.01	-1.02	-1.05	-1.06	-1.6
2	-1.48	-1.60	-1.61	-1.64	-2.4
3	-1.59	-1.88	-1.86	-1.83	-2.4
4	-1.65	-2.06	-2.02	-2.07	-2.4
5	-1.77	-2.26	-2.27	-2.27	-2.4
6	-3.12	-4.00	-4.00	-4.01	-2.4
7	-1.31	-1.59	-1.61	-1.61	-1.32,0.56
8	-0.77	-0.55	-0.57	-0.56	-1.32,0.56
9	-0.18	0.45	0.42	0.44	-1.32,0.56
10	0.15	0.78	0.75	0.77	-1.32,0.56
11	-1.38	-0.42	-0.46	-0.45	-1.32,0.56
12	1.57	1.78	1.71	1.78	2.8

Table 6.15 Equivalent Static Load Distribution θ = 90°

Panel #	Equivalent Peak Pressure for Load Effect				AS1170.2
	V_W	V_L	BM_{ridge}	AF_{Mem2}	
1	-1.32	-1.36	-1.23	-1.27	-2.6
2	-1.66	-1.79	-1.58	-1.61	-3.6, -1.6
3	-1.93	-2.04	-1.83	-1.87	-3.6, -1.6
4	-2.29	-2.39	-2.19	-2.23	-3.6, -1.6
5	-2.28	-2.36	-2.22	-2.21	-3.6, -1.6
6	-2.37	-2.43	-2.30	-2.29	-3.6, -1.6
7	-2.40	-2.43	-2.32	-2.29	-3.6, -1.6
8	-2.32	-2.34	-2.23	-2.20	-3.6, -1.6
9	-2.30	-2.28	-2.14	-2.15	-3.6, -1.6
10	-2.03	-1.99	-1.84	-1.87	-3.6, -1.6
11	-1.82	-1.72	-1.64	-1.16	-3.6, -1.6
12	-1.27	-1.28	-1.18	-1.20	-2.6

7 CSTS FULL-SCALE TEST EVALUATION

Pressure coefficients given in AS1170.2 (1983) were used to simulate wind loads in the tests on the full scale Nu-Steel building at the CSTS. Alternative pressure coefficients are given by AS1170.2 (1983) for approach winds perpendicular (ie. $\theta = 0^o$) and parallel (ie. $\theta = 90^o$) to the ridge. For $\theta = 0^o$, uniform pressure coefficients of -0.325 and -0.6 were obtained for the upwind and downwind slopes of the roof respectively. For $\theta = 90^o$, the pressure coefficient was -0.9 over trusses A to D which then progressively reduce towards the tail-end of the roof. The internal pressure coefficient with a dominant opening was 0.8.

Reardon(1990) indicated that the truss hold down force (ie. vertical reaction at the end of the trusses) was the appropriate parameter to be simulated. He indicated that that this would generate accurate axial forces on the truss members. A roof height design gust wind speed of 42 m/s, for $\theta = 0^o$, generated design pressures of -0.34 kPa, -0.63 kPa on the upwind and downwind slopes and 0.63 kPa and -0.31 kPa on the undersides of the windward and leeward roof overhangs. This combined with a design internal pressure of 0.84 kPa acting upwards on the roof resulted in windward and leeward hold down forces of 5.41 and 5.47 kN/m width respectively. Reardon (1990) suggested generating identical hold down forces of 5.44 kN/m width by applying a uniform load equivalent to 1.22 kPa on both upwind and downwind halves of the roof was a satisfactory loading arrangement, due to limitations with loading gear. For a roof height design gust wind speed of 42 m/s, for $\theta = 90^o$, the design pressures were -0.95 kPa, on the roof slopes and -0.63 kPa on the roof overhang undersides. This combined with a design internal pressure of 0.84 kPa acting upwards on the roof resulted in windward and leeward hold down forces of 6.93 kN/m width. These hold down forces were simulated by applying a uniform load equivalent to 1.50 kPa on both halves of the roof over trusses from A to D.

The load effects derived from applying a design gust wind speed of 42 m/s with the wind tunnel data and AS1170.2 (1989) with an internal pressure coefficient of 0.7 are compared with the corresponding CSTS simulation in Table 7.1. A gust wind speed of 42 m/s is equivalent to a mean wind speed of 21 m/s in AS 1170.2 terrain category 3 conditions.

Table 7.1 shows that the all load effects generated by the CSTS tests are larger than that derived from wind tunnel covariance integration method and that using AS1170.2 (1989) data, except for the axial loads on member #2. Lager load effects were obtained in the CSTS testing procedure mainly because an internal pressure coefficient of 0.8 was used instead of the 0.7 specified in AS1170.2(1989). Because the lack of correlation of pressures is un-accounted in the CSTS testing procedure, it generally imposes larger load effects than those from the wind tunnel study.

Table 7.1 Comparison of load effects for design gust wind speed 42 m/s at roof height

Load Effect	θ	CSTS Full Scale	Wind Tunnel	AS 1170.2 1989
V_W (kN)	0	6.39	4.75	6.23
V_L (kN)	0	6.39	4.72	6.04
BM_{Ridge} (Nm)	0	0.504	0.411	0.495
$AF_{Mem\ \#2}$ (kN)	0	11.61	9.90	12.61
V_W (kN)	90	8.32	6.24	7.93
V_L (kN)	90	8.32	6.27	7.93
Ridge BM (Nm)	90	0.655	0.525	0.661
AF Mem #2 (kN)	90	15.11	13.36	17.01

8 CONCLUSIONS AND RECOMMENDATIONS

The mean and peak pressure distributions on a typical low-rise house were obtained by carrying out a wind tunnel model study at a length scale of 1/50. The roof truss experiencing the largest wind load was identified as the second from the windward gable end. Selected load effects (ie. hold down forces etc.) were determined using the covariance integration method and compared with the design values obtained from using pressure coefficients prescribed in AS1170.2 (1989). The wind tunnel data were also used in evaluating the full scale house testing procedure employed at the CSTS.

The following conclusions were reached and recommendations made, based on the wind tunnel study and data analysis;

- The pressure coefficients prescribed in AS1170.2 satisfactorily enveloped the area averaged mean pressure data obtained in the wind tunnel on most of the building except for oblique approach winds (ie. $\theta = 30^o$ 45^o) in the region immediately downwind of the ridge. The underestimation of pressure in this region can be avoided by increasing the magnitude of the K_L local pressure factors given in AS1170.2.
- The pressure coefficients given in AS1170.2 in areas near the windward gable end, for approach winds parallel to the ridge (ie. $\theta = 90^o$) were substantially larger than the area averaged mean pressure data obtained in the wind tunnel. This results in significant level of conservatism in load effects derived from AS1170.2 for $\theta = 90^o$. The requirements of smaller load effects and large enough local pressures for cladding design may be achieved by reducing the magnitude of the pressure coefficients and increasing the magnitude of the K_L local pressure factor in AS1170.2.
- Selected load effects on the most heavily loaded truss derived from applying the covariance integration method to the wind tunnel data generally resulted in substantially smaller values compared with values obtained from applying AS1170.2 data.
- The equivalent static pressure distributions derived for the load effects considered on the truss experiencing the largest wind loads were contained within the peak pressures derived from AS1170.2.

9 REFERENCES

1. J. Armitt, (1968) “Eigenvector Analysis of pressure fluctuations on the West Burton instrumented cooling tower”, Central Electricity Research Laboratory (UK) Internal Report RD/L/N 114/68
2. Australian Standard SAA Loading Code Part 2 Wind Loads AS1170.2 (1989)
3. Australian Standard SAA Loading Code Part 2 Wind Loads AS1170.2 (1983)
4. L. S. Cochran and J. E. Cermak, (1992), Full and model scale cladding pressures on the Texas Tech University experimental building, Jour. of Wind Engg and Industrial Aerodyn (JWEIA), Vol. 43, 1589-1600.
5. R. J. Best and J. D. Holmes, (1983) “Use of Eigenvalues in the Covariance Integration Method for Determination of Wind Load Effects”, JWEIA, Vol. 13, 359-370
6. J. D. Ginger and C. W. Letchford, (1991) “Wind Loads on Canopy Roofs”, Dept. of Civil Engg Research Report No. CE132, The University of Queensland, Australia.

7. J. D. Ginger and C. W. Letchford, (1993)"Characteristics of Large Pressures in Regions of Flow Separation", JWEIA, Vol. 49, 301-310.
8. J. D. Ginger and C. W. Letchford, (1994) "Wind Loads on Planar Canopy Roofs - Part 2: Fluctuating Pressure Distributions and Correlations", JWEIA, Vol. 51, 357-370.
9. J. D Ginger and C. W. Letchford (1995), "Pressure factors for edge regions on low-rise building roofs", JWEIA, Vol. 54/55, 337-344.
10. J. D. Ginger and C. W. Letchford, (1997) "Net Pressures on a Low-Rise Full Scale Building", Proceedings 4APSOWE, Gold Coast Australia.
11. J. D. Holmes and R. J. Best, (1981) "An Approach to the determination of Wind Load Effects on Low-Rise Buildings", JWEIA, Vol. 7, 273-287
12. J. D. Holmes (1988a) "Distribution of Peak wind Loads on a Low-Rise Building", JWEIA, Vol. 29, 59-67
13. J. D. Holmes (1988b) "Analysis and Synthesis of Pressure Fluctuations on Bluff Bodies Using Eigenvectors", International Colloquium on Bluff Body Aerodynamics and its Applications, Kyoto, Japan.
14. J. D. Holmes (1992) "Optimized Peak Load Distributions", JWEIA, Vol. 41-44, 267-276.
15. M. Kasperski and H. J. Niemann, (1989) " Identification of Critical Load Distributions for Wind Loading", 5th Int Conf. on Structural Safety and Reliability, San Fransisco USA
16. M. Kasperski, (1990) " Non-linear Design to Wind Load using the L.R.C. method", Eurodyn'90 Conf., Bochum, Germany
17. G. F. Reardon, (1990) "Simulated Cyclone Wind Loading of a Nu-Steel House", James Cook CSTS Technical Report No. 36.
18. T. Stathopoulos and D. Surry, (1983) "Scale Effects in Wind Tunnel Testing of Low Buildings", JWEIA, Vol. 13, 313-326
19. Technical Record 440 (TR 440), (1983) "Guidelines for the Testing and Evaluation of Products for Cyclone-Prone Area", Experimental Building Station, Dept. of Housing and Construction.
20. B. J. Whitbread (1997) "Correlation of Pressures on Low-rise Building Roofs and its use in Design", BE Thesis, Dept. of Civil & Env. Engg. James Cook University, Townsville, Australia.

Appendix A Measured Panel Pressure Coefficients

Table A1(a) Mean Pressure Coefficients Referenced To Eaves Height, θ = 0 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.233	-0.248	-0.277	-0.272	-0.176	-0.167	-0.147	-0.147	-0.167	-0.176	-0.272	-0.277	-0.248	-0.233
W2	-0.239	-0.254	-0.284	-0.278	-0.183	-0.174	-0.157	-0.157	-0.174	-0.183	-0.278	-0.284	-0.254	-0.239
1	-0.235	-0.240	-0.266	-0.260	-0.192	-0.165	-0.125	-0.125	-0.165	-0.192	-0.260	-0.266	-0.240	-0.235
2	-0.375	-0.368	-0.384	-0.408	-0.388	-0.408	-0.388	-0.388	-0.408	-0.388	-0.408	-0.384	-0.368	-0.375
3	-0.370	-0.362	-0.374	-0.393	-0.347	-0.366	-0.351	-0.351	-0.366	-0.347	-0.393	-0.374	-0.362	-0.370
4	-0.385	-0.384	-0.313	-0.369	-0.338	-0.126	-0.313	-0.313	-0.126	-0.338	-0.369	-0.313	-0.384	-0.385
5	-0.392	-0.389	-0.332	-0.344	-0.305	-0.311	-0.295	-0.295	-0.311	-0.305	-0.344	-0.332	-0.389	-0.392
6	-0.401	-0.381	-0.350	-0.338	-0.293	-0.297	-0.279	-0.279	-0.297	-0.293	-0.338	-0.350	-0.381	-0.401
7	-0.202	-0.183	-0.102	-0.055	-0.063	-0.072	-0.103	-0.103	-0.072	-0.063	-0.055	-0.102	-0.183	-0.202
8	-0.081	0.007	0.056	0.080	0.045	0.042	0.041	0.041	0.042	0.045	0.080	0.056	0.007	-0.081
9	-0.024	0.099	0.153	0.173	0.143	0.137	0.143	0.143	0.137	0.143	0.173	0.153	0.099	-0.024
10	0.002	0.160	0.212	0.226	0.187	0.184	0.186	0.186	0.184	0.187	0.226	0.212	0.160	0.002
11	-0.170	-0.068	0.010	0.022	0.018	0.002	0.010	0.010	0.002	0.018	0.022	0.010	-0.068	-0.170
12	0.281	0.505	0.558	0.570	0.507	0.493	0.492	0.492	0.493	0.507	0.570	0.558	0.505	0.281
W3	0.375	0.563	0.599	0.602	0.531	0.516	0.509	0.509	0.516	0.531	0.602	0.599	0.563	0.375
W4	0.149	0.413	0.491	0.514	0.466	0.452	0.449	0.449	0.452	0.466	0.514	0.491	0.413	0.149

Table A1(b) Maximum Pressure Coefficients Referenced To Eaves Height, θ = 0 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.181	0.160	0.241	0.248	0.216	0.278	0.263	0.263	0.278	0.216	0.248	0.241	0.160	0.181
W2	0.227	0.194	0.185	0.167	0.183	0.185	0.231	0.231	0.185	0.183	0.167	0.185	0.194	0.227
1	0.215	0.198	0.152	0.192	0.202	0.286	0.254	0.254	0.286	0.202	0.192	0.152	0.198	0.215
2	0.219	0.347	0.145	0.199	0.246	0.250	0.284	0.284	0.250	0.246	0.199	0.145	0.347	0.219
3	0.199	0.136	0.140	0.127	0.212	0.181	0.225	0.225	0.181	0.212	0.127	0.140	0.136	0.199
4	0.137	0.108	0.103	0.124	0.070	0.251	0.169	0.169	0.251	0.070	0.124	0.103	0.108	0.137
5	0.094	0.079	0.077	0.081	0.087	0.073	0.072	0.072	0.073	0.087	0.081	0.077	0.079	0.094
6	0.109	0.068	0.050	0.068	0.047	0.065	0.052	0.052	0.065	0.047	0.068	0.050	0.068	0.109
7	0.401	0.343	0.405	0.478	0.373	0.400	0.385	0.385	0.400	0.373	0.478	0.405	0.343	0.401
8	0.796	0.826	0.905	0.810	0.691	0.653	0.725	0.725	0.653	0.691	0.810	0.905	0.826	0.796
9	0.832	1.041	0.949	1.094	0.904	0.932	0.917	0.917	0.932	0.904	1.094	0.949	1.041	0.832
10	0.895	1.194	1.215	1.294	1.104	1.089	1.307	1.307	1.089	1.104	1.294	1.215	1.194	0.895
11	1.293	1.708	1.647	1.813	1.506	1.758	1.458	1.458	1.758	1.506	1.813	1.647	1.708	1.293
12	1.806	2.280	2.456	2.524	2.122	2.047	2.007	2.007	2.047	2.122	2.524	2.456	2.280	1.806
W3	2.077	2.347	2.429	2.491	2.003	2.087	2.086	2.086	2.087	2.003	2.491	2.429	2.347	2.077
W4	1.609	2.054	1.826	2.014	1.759	1.668	1.729	1.729	1.668	1.759	2.014	1.826	2.054	1.609

Table A1(c) Minimum Pressure Coefficients Referenced To Eaves Height, θ = 0 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.796	-0.837	-0.871	-0.878	-0.819	-0.699	-0.598	-0.598	-0.699	-0.819	-0.878	-0.871	-0.837	-0.796
W2	-0.818	-0.866	-0.848	-0.896	-0.685	-0.624	-0.586	-0.586	-0.624	-0.685	-0.896	-0.848	-0.866	-0.818
1	-0.859	-0.882	-0.803	-0.831	-0.833	-0.881	-0.557	-0.557	-0.881	-0.833	-0.831	-0.803	-0.882	-0.859
2	-1.607	-1.490	-1.794	-1.930	-2.067	-2.695	-2.216	-2.216	-2.695	-2.067	-1.930	-1.794	-1.490	-1.607
3	-1.493	-1.198	-1.217	-1.319	-1.193	-1.330	-1.303	-1.303	-1.330	-1.193	-1.319	-1.217	-1.198	-1.493
4	-1.306	-1.256	-1.311	-1.363	-1.313	-1.048	-1.317	-1.317	-1.048	-1.313	-1.363	-1.311	-1.256	-1.306
5	-1.449	-1.535	-1.246	-1.116	-1.076	-1.183	-1.281	-1.281	-1.183	-1.076	-1.116	-1.246	-1.535	-1.449
6	-1.599	-1.315	-1.180	-1.121	-1.012	-1.028	-1.199	-1.199	-1.028	-1.012	-1.121	-1.180	-1.315	-1.599
7	-0.940	-0.791	-0.608	-0.646	-0.566	-0.624	-0.798	-0.798	-0.624	-0.566	-0.646	-0.608	-0.791	-0.940
8	-0.944	-0.759	-0.627	-0.554	-0.458	-0.417	-0.510	-0.510	-0.417	-0.458	-0.554	-0.627	-0.759	-0.944
9	-0.747	-0.507	-0.368	-0.369	-0.389	-0.428	-0.337	-0.337	-0.428	-0.389	-0.369	-0.368	-0.507	-0.747
10	-0.758	-0.590	-0.498	-0.500	-0.486	-0.433	-0.432	-0.432	-0.433	-0.486	-0.500	-0.498	-0.590	-0.758
11	-2.081	-1.804	-1.649	-1.917	-1.370	-1.606	-1.469	-1.469	-1.606	-1.370	-1.917	-1.649	-1.804	-2.081
12	-0.888	-0.451	-0.252	-0.185	-0.160	-0.239	-0.117	-0.117	-0.239	-0.160	-0.185	-0.252	-0.451	-0.888
W3	-0.877	-0.764	-0.229	-0.380	-0.169	-0.262	-0.271	-0.271	-0.262	-0.169	-0.380	-0.229	-0.764	-0.877
W4	-0.604	-0.294	-0.138	-0.204	-0.160	-0.271	-0.188	-0.188	-0.271	-0.160	-0.204	-0.138	-0.294	-0.604

Table A1(d) Standard Deviation Pressure Coefficients Referenced To Eaves Height, θ = 0 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.125	0.127	0.127	0.131	0.110	0.104	0.099	0.099	0.104	0.110	0.131	0.127	0.127	0.125
W2	0.124	0.125	0.129	0.134	0.108	0.101	0.098	0.098	0.101	0.108	0.134	0.129	0.125	0.124
1	0.123	0.125	0.125	0.131	0.115	0.123	0.093	0.093	0.123	0.115	0.131	0.125	0.125	0.123
2	0.179	0.161	0.154	0.167	0.185	0.212	0.201	0.201	0.212	0.185	0.167	0.154	0.161	0.179
3	0.161	0.140	0.136	0.146	0.139	0.152	0.151	0.151	0.152	0.139	0.146	0.136	0.140	0.161
4	0.154	0.145	0.143	0.141	0.133	0.125	0.141	0.141	0.125	0.133	0.141	0.143	0.145	0.154
5	0.151	0.146	0.138	0.132	0.117	0.123	0.128	0.128	0.123	0.117	0.132	0.138	0.146	0.151
6	0.158	0.143	0.133	0.129	0.112	0.117	0.118	0.118	0.117	0.112	0.129	0.133	0.143	0.158
7	0.136	0.121	0.106	0.110	0.094	0.099	0.101	0.101	0.099	0.094	0.110	0.106	0.121	0.136
8	0.154	0.146	0.141	0.140	0.118	0.116	0.123	0.123	0.116	0.118	0.140	0.141	0.146	0.154
9	0.160	0.161	0.152	0.161	0.142	0.144	0.144	0.144	0.144	0.142	0.161	0.152	0.161	0.160
10	0.176	0.196	0.194	0.205	0.177	0.179	0.184	0.184	0.179	0.177	0.205	0.194	0.196	0.176
11	0.318	0.360	0.328	0.339	0.290	0.299	0.294	0.294	0.299	0.290	0.339	0.328	0.360	0.318
12	0.316	0.308	0.284	0.279	0.251	0.249	0.235	0.235	0.249	0.251	0.279	0.284	0.308	0.316
W3	0.311	0.323	0.295	0.293	0.254	0.257	0.251	0.251	0.257	0.254	0.293	0.295	0.323	0.311
W4	0.221	0.251	0.227	0.226	0.202	0.200	0.197	0.197	0.200	0.202	0.226	0.227	0.251	0.221

Table A2(a) Mean Pressure Coefficients Referenced To Eaves Height, θ = 15 Degrees

Panel No.	Truss Reference													
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.258	-0.270	-0.250	-0.260	-0.266	-0.240	-0.180	-0.191	-0.180	-0.166	-0.176	-0.212	-0.190	-0.177
W2	-0.262	-0.275	-0.258	-0.268	-0.279	-0.254	-0.192	-0.199	-0.192	-0.183	-0.178	-0.215	-0.200	-0.197
1	-0.251	-0.259	-0.245	-0.253	-0.287	-0.289	-0.157	-0.163	-0.177	-0.185	-0.164	-0.207	-0.186	-0.181
2	-0.376	-0.368	-0.329	-0.359	-0.433	-0.456	-0.441	-0.463	-0.495	-0.473	-0.429	-0.439	-0.397	-0.379
3	-0.411	-0.396	-0.357	-0.384	-0.412	-0.425	-0.399	-0.431	-0.445	-0.423	-0.388	-0.393	-0.352	-0.345
4	-0.482	-0.448	-0.377	-0.423	-0.413	-0.178	-0.364	-0.395	-0.193	-0.393	-0.355	-0.376	-0.357	-0.364
5	-0.494	-0.486	-0.402	-0.411	-0.389	-0.386	-0.337	-0.359	-0.377	-0.359	-0.324	-0.350	-0.349	-0.375
6	-0.500	-0.488	-0.427	-0.400	-0.367	-0.360	-0.313	-0.351	-0.358	-0.339	-0.300	-0.325	-0.335	-0.382
7	-0.127	-0.183	-0.106	-0.069	-0.020	-0.017	-0.025	-0.063	-0.033	-0.032	-0.073	-0.139	-0.190	-0.250
8	0.099	0.080	0.101	0.096	0.067	0.066	0.073	0.057	0.051	0.047	0.042	-0.007	-0.055	-0.175
9	0.190	0.203	0.214	0.199	0.160	0.154	0.164	0.156	0.146	0.138	0.120	0.061	0.016	-0.141
10	0.239	0.269	0.277	0.250	0.215	0.206	0.208	0.204	0.188	0.178	0.152	0.097	0.051	-0.133
11	0.054	0.049	0.082	0.058	0.046	0.023	0.040	-0.002	-0.021	-0.012	-0.042	-0.085	-0.124	-0.264
12	0.534	0.617	0.608	0.571	0.537	0.512	0.512	0.529	0.522	0.507	0.480	0.406	0.350	0.066
W3	0.598	0.656	0.654	0.607	0.566	0.541	0.526	0.551	0.548	0.537	0.501	0.445	0.398	0.143
W4	0.377	0.526	0.581	0.550	0.520	0.496	0.465	0.488	0.482	0.462	0.412	0.337	0.248	-0.050

Table A2(b) Maximum Pressure Coefficients Referenced To Eaves Height, θ = 15 Degrees

Panel No.	Truss Reference													
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.127	0.118	0.131	0.176	0.169	0.242	0.315	0.333	0.341	0.350	0.318	0.267	0.333	0.319
W2	0.132	0.110	0.118	0.106	0.145	0.208	0.223	0.232	0.328	0.285	0.263	0.258	0.283	0.276
1	0.126	0.140	0.138	0.176	0.214	0.272	0.316	0.363	0.453	0.343	0.321	0.269	0.372	0.354
2	0.160	0.256	0.250	0.292	0.156	0.254	0.283	0.277	0.432	0.330	0.491	0.366	0.428	0.360
3	0.191	0.113	0.110	0.173	0.195	0.285	0.227	0.194	0.260	0.288	0.380	0.358	0.341	0.375
4	0.124	0.055	0.164	0.129	0.078	0.299	0.185	0.180	0.364	0.164	0.275	0.168	0.278	0.242
5	0.126	0.065	0.110	0.086	0.041	0.100	0.085	0.103	0.145	0.140	0.125	0.122	0.117	0.182
6	0.059	0.034	0.055	0.063	0.034	0.053	0.107	0.096	0.113	0.075	0.132	0.076	0.154	0.141
7	0.529	0.376	0.398	0.411	0.479	0.515	0.577	0.526	0.519	0.491	0.411	0.292	0.348	0.285
8	1.025	0.899	0.854	0.838	0.814	0.801	0.810	0.782	0.932	0.885	0.809	0.789	0.710	0.513
9	1.179	1.071	1.040	1.120	0.981	0.998	1.006	1.036	1.073	0.908	0.954	0.908	0.900	0.588
10	1.240	1.313	1.220	1.294	1.184	1.258	1.202	1.371	1.224	1.195	1.320	1.153	1.071	0.647
11	1.582	1.717	1.550	1.686	1.535	1.702	1.712	1.678	1.753	1.693	1.622	1.320	1.523	1.142
12	2.293	2.301	2.167	2.054	2.144	2.094	2.136	2.409	2.274	2.301	2.169	1.945	2.000	1.474
W3	2.309	2.327	2.242	2.305	2.259	2.325	2.328	2.363	2.512	2.187	2.543	2.292	2.136	1.716
W4	1.698	1.936	1.877	1.850	1.935	1.912	1.870	1.990	1.802	1.787	1.820	1.674	1.465	0.972

Table A2(c) Minimum Pressure Coefficients Referenced To Eaves Height, $\theta = 15$ Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.873	-0.898	-0.738	-0.813	-0.900	-0.897	-0.866	-0.801	-0.785	-0.734	-0.849	-0.970	-0.998	-0.928
W2	-0.808	-0.841	-0.760	-0.799	-0.864	-0.940	-0.759	-0.723	-0.825	-0.791	-0.747	-0.767	-0.830	-0.897
1	-0.762	-0.805	-0.793	-0.787	-0.912	-1.083	-0.704	-0.660	-0.848	-0.802	-0.767	-0.826	-0.870	-0.815
2	-1.418	-1.142	-1.164	-1.223	-1.726	-2.383	-2.427	-2.430	-3.167	-2.735	-2.689	-2.763	-2.885	-2.221
3	-1.503	-1.202	-1.079	-1.246	-1.301	-1.476	-1.517	-1.649	-1.812	-1.777	-2.022	-1.752	-1.592	-1.618
4	-1.971	-1.504	-1.201	-1.467	-1.425	-1.285	-1.722	-1.814	-1.420	-1.864	-1.918	-1.971	-1.747	-1.946
5	-2.464	-1.789	-1.351	-1.427	-1.513	-1.698	-1.750	-1.867	-1.921	-1.615	-1.860	-1.746	-1.763	-1.739
6	-2.307	-2.017	-1.502	-1.235	-1.261	-1.446	-1.455	-1.735	-1.724	-1.767	-1.643	-1.522	-1.902	-2.238
7	-1.730	-0.912	-0.678	-0.680	-0.614	-0.731	-0.730	-0.830	-0.807	-0.752	-0.778	-0.778	-0.952	-0.942
8	-1.129	-0.522	-0.472	-0.524	-0.481	-0.462	-0.503	-0.623	-0.522	-0.576	-0.649	-0.667	-0.606	-0.735
9	-0.933	-0.365	-0.311	-0.338	-0.325	-0.373	-0.377	-0.414	-0.460	-0.449	-0.388	-0.424	-0.558	-0.747
10	-1.061	-0.501	-0.325	-0.419	-0.499	-0.485	-0.538	-0.663	-0.585	-0.557	-0.597	-0.593	-0.660	-0.804
11	-1.575	-1.578	-1.141	-1.215	-1.304	-1.453	-1.599	-1.822	-1.811	-1.667	-1.687	-1.679	-1.911	-1.869
12	-0.540	-0.292	-0.097	-0.127	-0.095	-0.199	-0.212	-0.281	-0.272	-0.261	-0.261	-0.352	-0.516	-0.881
W3	-0.519	-0.331	-0.178	-0.177	-0.219	-0.254	-0.315	-0.232	-0.337	-0.358	-0.296	-0.463	-0.675	-0.862
W4	-0.358	-0.139	0.002	-0.049	-0.145	-0.184	-0.348	-0.178	-0.165	-0.135	-0.177	-0.203	-0.447	-0.762

Table A2(d) Standard Deviation Pressure Coefficients Referenced To Eaves Height, $\theta = 15$ Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.113	0.115	0.107	0.111	0.130	0.131	0.114	0.118	0.121	0.119	0.122	0.129	0.139	0.136
W2	0.115	0.117	0.115	0.117	0.128	0.126	0.115	0.116	0.120	0.120	0.119	0.127	0.137	0.136
1	0.110	0.113	0.107	0.111	0.137	0.172	0.112	0.117	0.125	0.125	0.119	0.125	0.137	0.132
2	0.158	0.149	0.141	0.149	0.180	0.210	0.232	0.246	0.282	0.250	0.241	0.236	0.232	0.220
3	0.167	0.152	0.140	0.147	0.152	0.169	0.172	0.184	0.194	0.184	0.186	0.173	0.172	0.175
4	0.214	0.175	0.165	0.166	0.164	0.153	0.172	0.174	0.162	0.176	0.180	0.183	0.173	0.173
5	0.248	0.202	0.173	0.163	0.155	0.165	0.158	0.165	0.171	0.160	0.160	0.165	0.168	0.170
6	0.235	0.209	0.181	0.157	0.143	0.151	0.149	0.160	0.157	0.150	0.148	0.148	0.162	0.177
7	0.152	0.134	0.114	0.111	0.113	0.120	0.115	0.124	0.123	0.115	0.110	0.107	0.118	0.128
8	0.167	0.146	0.142	0.134	0.127	0.127	0.131	0.141	0.134	0.133	0.131	0.143	0.125	0.124
9	0.174	0.162	0.151	0.155	0.150	0.154	0.153	0.167	0.163	0.156	0.149	0.139	0.142	0.134
10	0.187	0.192	0.184	0.190	0.187	0.190	0.193	0.208	0.203	0.197	0.188	0.177	0.173	0.145
11	0.313	0.327	0.297	0.303	0.287	0.302	0.311	0.337	0.344	0.328	0.327	0.315	0.338	0.291
12	0.301	0.281	0.254	0.245	0.248	0.247	0.242	0.274	0.277	0.275	0.269	0.268	0.280	0.256
W3	0.305	0.296	0.265	0.260	0.258	0.262	0.254	0.280	0.287	0.285	0.282	0.283	0.297	0.266
W4	0.224	0.239	0.220	0.213	0.211	0.209	0.200	0.222	0.222	0.217	0.215	0.212	0.211	0.179

Table A3(a) Mean Pressure Coefficients Referenced To Eaves Height, $\theta = 30$ Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.350	-0.364	-0.317	-0.290	-0.277	-0.266	-0.204	-0.164	-0.163	-0.145	-0.160	-0.140	-0.147	-0.156
W2	-0.375	-0.395	-0.371	-0.334	-0.326	-0.319	-0.262	-0.220	-0.216	-0.182	-0.177	-0.152	-0.167	-0.182
1	-0.357	-0.365	-0.325	-0.279	-0.288	-0.283	-0.195	-0.154	-0.182	-0.154	-0.147	-0.135	-0.136	-0.139
2	-0.530	-0.567	-0.414	-0.397	-0.414	-0.444	-0.423	-0.414	-0.439	-0.416	-0.434	-0.399	-0.353	-0.325
3	-0.698	-0.637	-0.366	-0.418	-0.479	-0.520	-0.491	-0.445	-0.436	-0.405	-0.433	-0.387	-0.344	-0.316
4	-1.110	-0.668	-0.549	-0.610	-0.659	-0.382	-0.569	-0.493	-0.261	-0.448	-0.483	-0.445	-0.393	-0.361
5	-1.542	-0.771	-0.812	-0.853	-0.718	-0.663	-0.606	-0.546	-0.513	-0.479	-0.488	-0.460	-0.508	-0.387
6	-1.464	-1.371	-1.075	-0.881	-0.718	-0.660	-0.577	-0.543	-0.504	-0.466	-0.466	-0.474	-0.528	-0.503
7	-0.555	-0.537	-0.418	-0.328	-0.201	-0.180	-0.190	-0.149	-0.121	-0.117	-0.177	-0.210	-0.275	-0.227
8	-0.095	-0.057	-0.066	-0.063	-0.042	-0.039	-0.038	-0.019	-0.027	-0.033	-0.032	-0.053	-0.080	-0.106
9	0.075	0.128	0.092	0.080	0.086	0.078	0.068	0.080	0.065	0.053	0.054	0.042	0.004	-0.055
10	0.204	0.208	0.162	0.134	0.139	0.123	0.099	0.116	0.094	0.076	0.085	0.075	0.032	-0.050
11	0.109	0.008	-0.021	-0.055	-0.038	-0.073	-0.086	-0.081	-0.091	-0.085	-0.105	-0.098	-0.125	-0.162
12	0.553	0.551	0.494	0.481	0.479	0.452	0.431	0.434	0.424	0.389	0.423	0.375	0.295	0.122
W3	0.593	0.580	0.523	0.499	0.494	0.470	0.442	0.465	0.432	0.399	0.427	0.400	0.311	0.157
W4	0.411	0.484	0.467	0.446	0.449	0.425	0.403	0.423	0.387	0.353	0.359	0.321	0.219	0.055

Table A3(b) Maximum Pressure Coefficients Referenced To Eaves Height, $\theta = 30$ Degrees

Panel	Truss Reference													
NO.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.005	0.035	0.090	0.188	0.257	0.330	0.346	0.425	0.416	0.371	0.391	0.333	0.374	0.444
W2	0.015	0.007	-0.021	0.043	0.058	0.089	0.137	0.211	0.275	0.277	0.267	0.318	0.290	0.277
1	0.005	0.006	0.021	0.149	0.183	0.412	0.288	0.378	0.472	0.391	0.416	0.363	0.425	0.394
2	-0.025	0.050	0.111	0.165	0.130	0.355	0.269	0.320	0.316	0.316	0.357	0.447	0.472	0.453
3	-0.100	0.049	0.106	0.139	0.061	0.134	0.309	0.204	0.254	0.293	0.316	0.350	0.413	0.427
4	-0.174	-0.054	-0.011	0.037	0.041	0.337	0.152	0.136	0.340	0.143	0.235	0.302	0.333	0.436
5	-0.162	-0.059	-0.126	-0.127	-0.025	0.076	0.034	0.161	0.108	0.113	0.152	0.228	0.277	0.377
6	-0.266	-0.289	-0.241	-0.194	-0.084	-0.045	-0.006	0.018	0.068	0.087	0.142	0.154	0.177	0.199
7	0.373	0.131	0.133	0.181	0.351	0.382	0.419	0.426	0.390	0.362	0.402	0.370	0.252	0.214
8	0.951	0.698	0.784	0.580	0.592	0.563	0.630	0.641	0.570	0.584	0.753	0.594	0.488	0.357
9	1.073	0.998	0.899	0.972	0.860	0.869	0.770	0.935	0.898	0.842	0.835	0.717	0.808	0.539
10	1.286	1.215	1.056	1.110	1.041	1.083	1.129	1.067	1.047	1.008	1.083	0.932	0.913	0.602
11	1.545	1.635	1.336	1.359	1.458	1.479	1.306	1.307	1.425	1.238	1.345	1.363	1.234	0.850
12	2.062	2.248	1.933	1.840	2.037	2.234	2.208	1.962	2.075	1.856	1.925	1.891	1.689	1.175
W3	2.157	2.289	2.212	2.203	1.902	1.907	2.181	2.114	2.132	1.927	1.918	1.907	1.873	1.358
W4	1.601	1.949	1.641	1.694	1.716	1.691	1.653	1.522	1.515	1.494	1.593	1.514	1.388	0.871

Table A3(c) Minimum Pressure Coefficients Referenced To Eaves Height, $\theta = 30$ Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.886	-0.939	-0.894	-0.861	-0.870	-0.956	-0.839	-0.888	-1.066	-1.026	-0.865	-0.810	-0.804	-0.818
W2	-1.002	-1.094	-1.037	-0.894	-0.861	-0.905	-0.815	-0.833	-0.965	-0.819	-0.779	-0.756	-0.793	-0.799
1	-0.960	-1.022	-0.832	-0.785	-0.908	-1.134	-0.776	-0.739	-0.858	-0.742	-0.745	-0.759	-0.751	-0.712
2	-1.934	-1.582	-1.241	-1.303	-1.387	-1.769	-1.698	-1.909	-2.087	-1.874	-2.338	-2.627	-2.383	-2.124
3	-1.880	-1.876	-1.221	-1.515	-1.651	-1.765	-1.599	-1.566	-1.661	-1.522	-1.789	-1.695	-1.927	-2.082
4	-3.039	-2.117	-1.835	-1.917	-1.911	-1.491	-1.883	-1.592	-1.619	-1.936	-1.991	-2.083	-1.932	-2.044
5	-4.681	-2.245	-2.394	-2.322	-2.194	-2.337	-2.369	-2.130	-2.433	-2.065	-2.236	-2.126	-2.681	-1.943
6	-4.164	-4.067	-2.954	-2.509	-2.171	-2.626	-2.256	-2.291	-2.304	-2.219	-2.278	-2.169	-2.842	-3.055
7	-2.817	-1.788	-1.164	-1.080	-0.842	-0.889	-0.856	-0.845	-0.913	-0.860	-0.915	-0.953	-1.226	-1.005
8	-2.003	-0.915	-0.683	-0.606	-0.602	-0.593	-0.630	-0.578	-0.601	-0.620	-0.627	-0.736	-0.695	-0.682
9	-1.787	-0.676	-0.482	-0.555	-0.410	-0.458	-0.481	-0.545	-0.424	-0.452	-0.552	-0.476	-0.535	-0.580
10	-2.369	-0.518	-0.529	-0.606	-0.514	-0.649	-0.693	-0.608	-0.667	-0.663	-0.755	-0.722	-0.748	-0.717
11	-1.425	-1.386	-1.453	-1.529	-1.538	-1.763	-1.865	-1.965	-1.796	-1.628	-1.914	-1.680	-2.081	-1.547
12	-0.508	-0.165	-0.151	-0.263	-0.166	-0.171	-0.253	-0.249	-0.314	-0.231	-0.334	-0.325	-0.436	-0.532
W3	-0.585	-0.219	-0.155	-0.222	-0.240	-0.224	-0.399	-0.372	-0.279	-0.264	-0.431	-0.401	-0.578	-0.572
W4	-0.372	-0.158	-0.035	-0.096	-0.122	-0.036	-0.183	-0.088	-0.149	-0.122	-0.198	-0.185	-0.389	-0.475

Table A3(d) Standard Deviation Pressure Coefficients Referenced To Eaves Height, $\theta = 30$ Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.114	0.122	0.109	0.115	0.124	0.135	0.128	0.131	0.143	0.131	0.125	0.118	0.122	0.116
W2	0.121	0.129	0.117	0.112	0.115	0.122	0.114	0.113	0.124	0.118	0.119	0.115	0.119	0.121
1	0.113	0.119	0.103	0.105	0.121	0.141	0.115	0.118	0.132	0.125	0.122	0.118	0.121	0.118
2	0.170	0.184	0.144	0.145	0.173	0.207	0.192	0.198	0.223	0.198	0.230	0.232	0.239	0.229
3	0.220	0.219	0.144	0.183	0.198	0.206	0.184	0.180	0.186	0.172	0.198	0.190	0.194	0.197
4	0.369	0.251	0.223	0.252	0.231	0.200	0.206	0.194	0.179	0.192	0.224	0.211	0.215	0.222
5	0.575	0.271	0.287	0.280	0.250	0.243	0.230	0.211	0.223	0.210	0.231	0.225	0.272	0.222
6	0.492	0.477	0.351	0.289	0.254	0.244	0.217	0.209	0.211	0.197	0.218	0.239	0.304	0.330
7	0.323	0.190	0.158	0.146	0.126	0.128	0.128	0.123	0.120	0.114	0.134	0.142	0.156	0.126
8	0.313	0.144	0.138	0.123	0.119	0.118	0.125	0.124	0.117	0.115	0.127	0.121	0.113	0.098
9	0.283	0.154	0.137	0.141	0.137	0.142	0.134	0.137	0.138	0.131	0.140	0.129	0.121	0.103
10	0.243	0.176	0.170	0.176	0.170	0.175	0.182	0.177	0.174	0.169	0.180	0.168	0.153	0.118
11	0.292	0.297	0.264	0.272	0.270	0.288	0.289	0.295	0.298	0.277	0.315	0.296	0.286	0.226
12	0.265	0.245	0.222	0.218	0.221	0.222	0.212	0.218	0.228	0.219	0.250	0.244	0.231	0.184
W3	0.280	0.267	0.239	0.239	0.224	0.227	0.230	0.239	0.234	0.225	0.251	0.246	0.239	0.197
W4	0.199	0.212	0.197	0.192	0.183	0.182	0.182	0.188	0.184	0.177	0.192	0.185	0.167	0.131

Table A4(a) Mean Pressure Coefficients Referenced To Eaves Height, θ = 45 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.304	-0.333	-0.338	-0.306	-0.247	-0.215	-0.160	-0.084	-0.048	-0.018	-0.048	-0.044	-0.054	-0.096
W2	-0.316	-0.339	-0.366	-0.338	-0.289	-0.269	-0.230	-0.178	-0.142	-0.114	-0.111	-0.101	-0.120	-0.168
1	-0.298	-0.310	-0.340	-0.301	-0.260	-0.247	-0.161	-0.088	-0.070	-0.040	-0.036	-0.039	-0.065	-0.084
2	-0.583	-0.537	-0.513	-0.406	-0.306	-0.276	-0.254	-0.246	-0.268	-0.324	-0.309	-0.284	-0.297	-0.281
3	-0.636	-0.634	-0.470	-0.343	-0.262	-0.269	-0.310	-0.376	-0.392	-0.383	-0.381	-0.328	-0.307	-0.280
4	-0.855	-0.778	-0.461	-0.329	-0.364	-0.215	-0.548	-0.622	-0.338	-0.504	-0.437	-0.402	-0.337	-0.310
5	-1.359	-0.714	-0.930	-0.751	-0.898	-0.887	-0.772	-0.717	-0.628	-0.534	-0.454	-0.397	-0.405	-0.329
6	-1.323	-1.479	-1.399	-1.219	-0.962	-0.835	-0.746	-0.704	-0.617	-0.532	-0.441	-0.392	-0.429	-0.416
7	-0.842	-0.589	-0.532	-0.469	-0.324	-0.285	-0.289	-0.265	-0.203	-0.175	-0.170	-0.176	-0.239	-0.212
8	-0.438	-0.141	-0.144	-0.141	-0.115	-0.105	-0.111	-0.088	-0.071	-0.065	-0.042	-0.087	-0.093	-0.117
9	-0.256	0.055	-0.007	-0.005	0.010	0.009	-0.009	0.026	0.026	0.024	0.027	0.020	-0.033	-0.081
10	-0.075	0.161	0.056	0.045	0.054	0.043	0.015	0.049	0.051	0.043	0.049	0.038	-0.022	-0.085
11	0.130	0.023	-0.075	-0.094	-0.073	-0.103	-0.130	-0.129	-0.126	-0.113	-0.090	-0.085	-0.142	-0.164
12	0.379	0.401	0.307	0.330	0.330	0.324	0.311	0.360	0.341	0.306	0.313	0.257	0.173	0.030
W3	0.395	0.405	0.312	0.311	0.339	0.334	0.294	0.368	0.348	0.319	0.306	0.275	0.184	0.049
W4	0.313	0.366	0.304	0.303	0.313	0.306	0.261	0.333	0.321	0.290	0.266	0.229	0.125	-0.003

Table A4(b) Maximum Pressure Coefficients Referenced To Eaves Height, θ = 45 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.050	0.043	0.035	0.113	0.222	0.335	0.366	0.534	0.599	0.628	0.552	0.515	0.620	0.463
W2	0.053	0.053	-0.021	0.047	0.111	0.141	0.142	0.284	0.303	0.297	0.321	0.314	0.352	0.233
1	0.050	0.047	-0.007	0.093	0.200	0.319	0.434	0.472	0.569	0.567	0.545	0.541	0.598	0.547
2	0.031	0.193	0.144	0.252	0.225	0.261	0.215	0.302	0.463	0.299	0.325	0.267	0.385	0.304
3	-0.029	0.015	0.163	0.247	0.210	0.169	0.126	0.234	0.323	0.218	0.259	0.242	0.277	0.319
4	-0.189	-0.073	0.025	0.133	0.123	0.344	0.069	0.137	0.323	0.250	0.240	0.220	0.281	0.259
5	-0.200	-0.033	-0.085	-0.006	-0.065	-0.076	-0.118	-0.007	0.049	0.121	0.149	0.179	0.295	0.307
6	-0.147	-0.068	-0.194	-0.221	-0.210	-0.142	-0.102	-0.058	0.054	0.062	0.140	0.139	0.208	0.241
7	0.300	0.101	0.086	0.084	0.187	0.249	0.233	0.237	0.342	0.316	0.276	0.261	0.273	0.192
8	0.838	0.633	0.514	0.440	0.440	0.457	0.499	0.559	0.467	0.514	0.520	0.534	0.566	0.405
9	1.037	0.866	0.655	0.678	0.657	0.719	0.712	0.793	0.707	0.668	0.679	0.610	0.598	0.402
10	1.176	1.107	0.868	0.856	0.798	0.866	0.801	1.011	0.836	0.855	0.864	0.751	0.739	0.419
11	1.414	1.353	1.010	1.073	0.973	1.107	1.182	1.172	1.196	1.091	1.076	0.943	0.913	0.719
12	2.002	1.755	1.743	1.810	1.616	1.628	1.679	1.762	1.709	1.628	1.750	1.566	1.210	0.806
W3	1.951	1.946	1.616	1.447	1.608	1.660	1.717	1.686	1.719	1.640	1.572	1.475	1.435	0.954
W4	1.522	1.550	1.379	1.340	1.310	1.368	1.206	1.315	1.362	1.257	1.164	1.093	0.950	0.585

Table A4(c) Minimum Pressure Coefficients Referenced To Eaves Height, $\theta = 45$ Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.864	-0.978	-0.838	-0.836	-0.795	-0.854	-0.716	-0.779	-0.842	-0.825	-0.790	-0.689	-0.770	-0.661
W2	-0.900	-0.903	-0.911	-0.902	-0.836	-0.796	-0.742	-0.766	-0.793	-0.795	-0.686	-0.662	-0.672	-0.759
1	-0.762	-0.790	-0.869	-0.796	-0.798	-0.986	-0.676	-0.660	-0.783	-0.676	-0.596	-0.582	-0.621	-0.589
2	-2.693	-2.097	-1.437	-1.246	-0.964	-1.129	-1.222	-1.620	-1.910	-1.543	-1.518	-1.488	-1.760	-1.632
3	-2.749	-1.754	-1.459	-1.209	-1.211	-1.383	-1.560	-1.980	-1.615	-1.361	-1.619	-1.320	-1.352	-1.291
4	-2.733	-2.071	-1.639	-1.467	-1.777	-1.571	-2.029	-1.944	-1.491	-1.594	-1.696	-1.656	-1.494	-1.608
5	-4.536	-2.127	-2.591	-2.633	-2.408	-2.308	-2.006	-2.129	-2.007	-1.778	-1.940	-1.878	-2.026	-1.502
6	-3.911	-4.318	-3.544	-2.902	-2.331	-2.181	-2.024	-2.168	-2.527	-2.318	-2.095	-2.100	-2.694	-2.918
7	-3.226	-2.049	-1.331	-1.223	-0.931	-0.976	-0.965	-1.005	-0.925	-0.841	-0.813	-0.780	-0.903	-0.806
8	-2.755	-1.618	-0.845	-0.682	-0.668	-0.635	-0.734	-0.621	-0.593	-0.627	-0.549	-0.678	-0.668	-0.585
9	-2.281	-1.276	-0.485	-0.515	-0.475	-0.488	-0.574	-0.544	-0.493	-0.468	-0.454	-0.428	-0.618	-0.586
10	-3.120	-0.538	-0.646	-0.731	-0.627	-0.731	-0.787	-0.899	-0.874	-0.843	-0.647	-0.606	-0.762	-0.632
11	-1.764	-1.284	-1.380	-1.542	-1.438	-1.960	-1.817	-1.951	-1.904	-1.715	-1.689	-1.513	-1.870	-1.630
12	-1.195	-0.601	-0.278	-0.236	-0.215	-0.231	-0.288	-0.310	-0.297	-0.307	-0.361	-0.325	-0.480	-0.498
W3	-1.453	-0.709	-0.348	-0.370	-0.222	-0.270	-0.302	-0.349	-0.352	-0.333	-0.350	-0.315	-0.502	-0.552
W4	-1.219	-0.645	-0.211	-0.263	-0.104	-0.194	-0.191	-0.158	-0.127	-0.158	-0.227	-0.228	-0.365	-0.438

Table A4(d) Standard Deviation Pressure Coefficients Referenced To Eaves Height, $\theta = 45$ Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.106	0.113	0.106	0.113	0.113	0.121	0.114	0.130	0.141	0.132	0.132	0.126	0.136	0.122
W2	0.106	0.112	0.107	0.112	0.109	0.114	0.104	0.115	0.116	0.110	0.108	0.103	0.109	0.104
1	0.102	0.107	0.102	0.108	0.114	0.140	0.104	0.117	0.134	0.125	0.118	0.116	0.124	0.116
2	0.259	0.201	0.175	0.165	0.126	0.130	0.123	0.179	0.215	0.201	0.178	0.161	0.166	0.152
3	0.232	0.200	0.181	0.149	0.119	0.147	0.172	0.239	0.233	0.195	0.174	0.154	0.149	0.145
4	0.273	0.240	0.173	0.140	0.203	0.236	0.264	0.267	0.207	0.200	0.183	0.175	0.170	0.168
5	0.489	0.245	0.294	0.365	0.341	0.302	0.248	0.245	0.238	0.207	0.201	0.188	0.220	0.177
6	0.474	0.539	0.415	0.347	0.293	0.269	0.234	0.237	0.231	0.211	0.204	0.202	0.238	0.278
7	0.405	0.223	0.170	0.157	0.130	0.130	0.128	0.136	0.131	0.120	0.117	0.115	0.129	0.112
8	0.419	0.194	0.119	0.110	0.109	0.109	0.115	0.126	0.117	0.116	0.109	0.115	0.105	0.091
9	0.424	0.176	0.115	0.119	0.117	0.124	0.121	0.131	0.131	0.124	0.116	0.106	0.108	0.091
10	0.464	0.158	0.143	0.150	0.145	0.152	0.157	0.170	0.169	0.162	0.150	0.137	0.132	0.101
11	0.251	0.255	0.224	0.234	0.230	0.250	0.251	0.285	0.277	0.257	0.250	0.233	0.245	0.187
12	0.284	0.217	0.196	0.191	0.190	0.192	0.184	0.213	0.202	0.189	0.189	0.175	0.177	0.138
W3	0.302	0.228	0.191	0.188	0.181	0.186	0.189	0.206	0.202	0.192	0.186	0.177	0.183	0.145
W4	0.219	0.187	0.168	0.162	0.151	0.152	0.148	0.168	0.164	0.155	0.140	0.131	0.129	0.104

Table A5(a) Mean Pressure Coefficients Referenced To Eaves Height, θ = 60 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.280	-0.309	-0.340	-0.289	-0.223	-0.177	-0.148	-0.065	-0.027	0.007	-0.020	-0.037	0.010	-0.032
W2	-0.295	-0.311	-0.354	-0.318	-0.261	-0.225	-0.199	-0.124	-0.088	-0.060	-0.081	-0.103	-0.077	-0.141
1	-0.298	-0.301	-0.319	-0.280	-0.254	-0.222	-0.149	-0.068	-0.033	-0.007	-0.018	-0.047	-0.025	-0.062
2	-0.683	-0.542	-0.488	-0.393	-0.288	-0.232	-0.191	-0.123	-0.088	-0.112	-0.134	-0.154	-0.146	-0.188
3	-0.679	-0.600	-0.477	-0.346	-0.253	-0.203	-0.169	-0.127	-0.111	-0.107	-0.168	-0.191	-0.197	-0.218
4	-0.771	-0.729	-0.449	-0.293	-0.246	-0.004	-0.214	-0.234	-0.077	-0.268	-0.327	-0.274	-0.270	-0.255
5	-1.015	-0.732	-0.669	-0.370	-0.459	-0.504	-0.505	-0.504	-0.484	-0.435	-0.413	-0.316	-0.285	-0.249
6	-1.068	-0.981	-0.890	-0.813	-0.739	-0.649	-0.557	-0.541	-0.504	-0.434	-0.384	-0.359	-0.296	-0.280
7	-0.896	-0.569	-0.320	-0.259	-0.238	-0.214	-0.205	-0.189	-0.145	-0.125	-0.163	-0.189	-0.181	-0.195
8	-0.725	-0.307	-0.084	-0.073	-0.099	-0.086	-0.081	-0.053	-0.044	-0.037	-0.063	-0.060	-0.094	-0.146
9	-0.611	-0.157	-0.009	0.001	-0.021	-0.014	-0.011	0.013	0.020	0.023	-0.012	-0.053	-0.053	-0.113
10	-0.554	0.007	0.030	0.031	0.013	0.014	0.014	0.031	0.032	0.029	0.003	-0.042	-0.049	-0.121
11	-0.104	-0.038	-0.023	-0.022	-0.038	-0.051	-0.048	-0.065	-0.066	-0.058	-0.082	-0.118	-0.118	-0.163
12	0.039	0.123	0.151	0.187	0.159	0.163	0.198	0.214	0.206	0.186	0.168	0.084	0.068	-0.054
W3	0.045	0.128	0.167	0.183	0.171	0.174	0.178	0.225	0.207	0.188	0.165	0.104	0.067	-0.051
W4	0.034	0.124	0.176	0.186	0.173	0.173	0.175	0.206	0.194	0.174	0.151	0.088	0.047	-0.068

Table A5(b) Maximum Pressure Coefficients Referenced To Eaves Height, θ = 60 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.152	0.165	0.043	0.100	0.169	0.264	0.276	0.409	0.457	0.518	0.507	0.454	0.578	0.431
W2	0.083	0.081	0.003	0.045	0.148	0.218	0.184	0.281	0.324	0.319	0.278	0.264	0.319	0.207
1	0.092	0.103	0.038	0.097	0.139	0.282	0.240	0.334	0.439	0.435	0.454	0.462	0.541	0.465
2	0.061	0.286	0.176	0.308	0.221	0.338	0.301	0.354	0.337	0.265	0.344	0.275	0.246	0.189
3	0.015	0.091	0.085	0.224	0.216	0.300	0.241	0.229	0.307	0.283	0.293	0.229	0.288	0.212
4	-0.068	0.013	0.101	0.220	0.186	0.376	0.208	0.257	0.383	0.257	0.205	0.210	0.201	0.201
5	-0.163	0.016	0.146	0.198	0.149	0.158	0.180	0.210	0.182	0.149	0.113	0.173	0.259	0.197
6	-0.059	0.029	0.191	0.249	0.128	0.154	0.084	0.132	0.137	0.135	0.126	0.135	0.222	0.214
7	0.348	0.248	0.243	0.339	0.221	0.265	0.302	0.326	0.314	0.290	0.283	0.220	0.249	0.189
8	0.794	0.632	0.598	0.462	0.385	0.373	0.450	0.444	0.398	0.427	0.403	0.435	0.376	0.225
9	0.793	0.687	0.526	0.513	0.441	0.479	0.559	0.563	0.600	0.551	0.472	0.394	0.388	0.234
10	1.129	0.844	0.648	0.707	0.588	0.587	0.605	0.639	0.675	0.657	0.565	0.490	0.567	0.307
11	0.986	0.892	0.849	0.889	0.746	0.810	0.834	0.840	0.818	0.761	0.864	0.713	0.628	0.425
12	1.448	1.360	1.132	1.113	1.168	1.106	1.125	1.122	1.233	1.120	1.037	0.920	0.798	0.499
W3	1.523	1.368	1.126	1.052	1.041	1.040	1.134	1.318	1.109	1.061	1.034	1.021	0.862	0.560
W4	1.176	1.162	1.022	0.989	0.887	0.886	0.875	0.917	0.901	0.847	0.841	0.672	0.637	0.419

Table A5(c) Minimum Pressure Coefficients Referenced To Eaves Height, $\theta = 60$ Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.952	-1.109	-1.136	-0.855	-0.765	-0.765	-0.693	-0.630	-0.647	-0.565	-0.566	-0.485	-0.512	-0.559
W2	-1.004	-0.996	-0.908	-0.879	-0.881	-0.882	-0.787	-0.651	-0.640	-0.514	-0.473	-0.460	-0.508	-0.595
1	-0.896	-0.889	-0.862	-0.838	-0.910	-0.995	-0.679	-0.547	-0.582	-0.432	-0.407	-0.449	-0.481	-0.440
2	-2.866	-2.397	-1.756	-1.436	-1.065	-1.003	-0.737	-0.843	-0.849	-0.963	-1.085	-1.138	-1.044	-0.891
3	-2.964	-2.105	-1.446	-1.266	-0.988	-0.976	-0.984	-1.124	-1.289	-1.141	-1.141	-1.008	-1.005	-0.909
4	-2.569	-2.142	-1.546	-1.125	-1.164	-1.172	-1.613	-1.725	-1.203	-1.344	-1.330	-1.175	-1.120	-1.058
5	-3.599	-2.141	-2.198	-1.869	-2.075	-2.027	-1.772	-1.672	-1.693	-1.440	-1.490	-1.322	-1.337	-1.161
6	-3.621	-3.372	-2.849	-2.530	-2.075	-1.929	-1.732	-1.768	-1.732	-1.627	-1.477	-1.470	-1.594	-1.991
7	-3.196	-2.169	-1.299	-1.040	-0.886	-0.872	-0.811	-0.847	-0.814	-0.692	-0.692	-0.700	-0.784	-0.673
8	-2.899	-1.928	-1.320	-0.719	-0.599	-0.531	-0.611	-0.631	-0.525	-0.511	-0.621	-0.692	-0.628	-0.604
9	-2.568	-1.931	-0.753	-0.467	-0.438	-0.461	-0.484	-0.487	-0.422	-0.436	-0.466	-0.481	-0.505	-0.493
10	-3.975	-1.601	-0.496	-0.525	-0.573	-0.578	-0.807	-0.724	-0.604	-0.629	-0.665	-0.660	-0.707	-0.621
11	-3.103	-1.402	-1.192	-1.254	-1.330	-1.413	-1.596	-1.563	-1.533	-1.480	-1.567	-1.390	-1.545	-1.429
12	-1.763	-1.284	-0.779	-0.494	-0.414	-0.355	-0.279	-0.244	-0.293	-0.290	-0.292	-0.341	-0.459	-0.494
W3	-1.510	-1.243	-0.898	-0.564	-0.480	-0.370	-0.379	-0.333	-0.313	-0.300	-0.367	-0.452	-0.581	-0.530
W4	-1.909	-1.342	-0.648	-0.409	-0.302	-0.266	-0.207	-0.194	-0.240	-0.220	-0.273	-0.309	-0.354	-0.466

Table A5(d) Standard Deviation Pressure Coefficients Referenced To Eaves Height, $\theta = 60$ Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.112	0.120	0.112	0.109	0.107	0.110	0.100	0.107	0.109	0.100	0.102	0.096	0.101	0.094
W2	0.108	0.113	0.110	0.113	0.111	0.114	0.102	0.106	0.102	0.092	0.086	0.082	0.089	0.088
1	0.106	0.112	0.107	0.110	0.116	0.139	0.098	0.098	0.100	0.092	0.089	0.087	0.093	0.089
2	0.320	0.244	0.182	0.167	0.132	0.131	0.106	0.107	0.108	0.107	0.109	0.113	0.129	0.115
3	0.278	0.213	0.167	0.157	0.122	0.116	0.101	0.115	0.132	0.132	0.143	0.139	0.139	0.115
4	0.256	0.237	0.174	0.134	0.118	0.120	0.159	0.206	0.191	0.201	0.191	0.161	0.133	0.112
5	0.376	0.249	0.284	0.208	0.275	0.293	0.254	0.250	0.236	0.198	0.169	0.160	0.144	0.121
6	0.417	0.399	0.393	0.344	0.272	0.249	0.211	0.226	0.214	0.187	0.169	0.159	0.166	0.170
7	0.381	0.256	0.159	0.143	0.119	0.116	0.112	0.119	0.112	0.102	0.101	0.095	0.102	0.093
8	0.372	0.277	0.131	0.101	0.091	0.089	0.094	0.102	0.093	0.092	0.093	0.096	0.089	0.078
9	0.383	0.268	0.103	0.096	0.090	0.095	0.097	0.101	0.102	0.097	0.095	0.087	0.088	0.077
10	0.525	0.170	0.109	0.113	0.106	0.110	0.118	0.128	0.122	0.117	0.117	0.108	0.107	0.086
11	0.360	0.202	0.169	0.175	0.167	0.182	0.184	0.207	0.201	0.183	0.190	0.175	0.180	0.138
12	0.307	0.245	0.167	0.148	0.132	0.131	0.132	0.145	0.139	0.129	0.136	0.120	0.121	0.098
W3	0.333	0.253	0.163	0.142	0.133	0.134	0.134	0.148	0.140	0.132	0.128	0.122	0.124	0.099
W4	0.282	0.226	0.151	0.129	0.119	0.117	0.113	0.119	0.118	0.110	0.105	0.098	0.094	0.082

Table A6(a) Mean Pressure Coefficients Referenced To Eaves Height, θ = 75 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.295	-0.315	-0.262	-0.205	-0.164	-0.114	-0.030	-0.040	0.012	0.026	0.011	0.015	0.003	-0.025
W2	-0.276	-0.294	-0.266	-0.231	-0.198	-0.142	-0.060	-0.084	-0.032	-0.021	-0.030	-0.023	-0.035	-0.065
1	-0.268	-0.280	-0.245	-0.205	-0.203	-0.149	-0.023	-0.049	-0.009	-0.006	0.002	0.001	-0.005	-0.014
2	-0.712	-0.492	-0.358	-0.264	-0.196	-0.146	-0.049	-0.087	-0.043	-0.058	-0.043	-0.030	-0.033	-0.048
3	-0.659	-0.542	-0.349	-0.232	-0.157	-0.106	-0.029	-0.071	-0.037	-0.030	-0.038	-0.024	-0.034	-0.052
4	-0.646	-0.614	-0.343	-0.203	-0.135	0.100	-0.020	-0.067	0.111	-0.059	-0.063	-0.085	-0.066	-0.074
5	-0.729	-0.637	-0.409	-0.190	-0.164	-0.150	-0.105	-0.163	-0.150	-0.151	-0.155	-0.115	-0.103	-0.080
6	-0.813	-0.681	-0.476	-0.379	-0.343	-0.299	-0.199	-0.260	-0.237	-0.219	-0.177	-0.144	-0.111	-0.076
7	-0.736	-0.521	-0.213	-0.094	-0.058	-0.041	-0.008	-0.060	-0.036	-0.037	-0.059	-0.062	-0.049	-0.042
8	-0.713	-0.442	-0.094	0.003	0.001	0.013	0.046	-0.008	0.005	0.001	-0.005	-0.021	-0.006	-0.020
9	-0.739	-0.370	-0.026	0.044	0.037	0.046	0.075	0.021	0.027	0.024	0.013	0.003	0.005	-0.010
10	-0.798	-0.158	0.025	0.054	0.055	0.061	0.086	0.030	0.030	0.024	0.019	0.007	0.008	-0.018
11	-0.444	-0.093	-0.003	0.027	0.036	0.035	0.061	-0.009	-0.005	-0.009	-0.011	-0.023	-0.017	-0.027
12	-0.101	-0.057	0.047	0.103	0.116	0.131	0.170	0.101	0.103	0.086	0.075	0.041	0.051	0.005
W3	-0.116	-0.064	0.043	0.101	0.132	0.140	0.154	0.112	0.098	0.082	0.076	0.050	0.049	0.007
W4	-0.106	-0.045	0.066	0.112	0.140	0.149	0.159	0.110	0.098	0.083	0.068	0.039	0.044	0.001

Table A6(b) Maximum Pressure Coefficients Referenced To Eaves Height, θ = 75 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.238	0.298	0.267	0.295	0.242	0.372	0.414	0.399	0.446	0.434	0.433	0.366	0.418	0.317
W2	0.259	0.271	0.299	0.292	0.268	0.436	0.387	0.387	0.452	0.407	0.341	0.293	0.273	0.195
1	0.303	0.329	0.318	0.338	0.280	0.414	0.466	0.445	0.490	0.428	0.362	0.330	0.376	0.338
2	0.163	0.416	0.456	0.488	0.368	0.499	0.482	0.428	0.451	0.356	0.378	0.344	0.312	0.244
3	0.147	0.235	0.321	0.510	0.394	0.441	0.406	0.381	0.417	0.359	0.337	0.296	0.296	0.238
4	0.197	0.249	0.334	0.474	0.389	0.556	0.406	0.400	0.517	0.323	0.315	0.312	0.290	0.242
5	0.121	0.183	0.425	0.480	0.447	0.504	0.382	0.389	0.356	0.310	0.292	0.292	0.312	0.254
6	0.228	0.267	0.515	0.678	0.520	0.548	0.465	0.347	0.417	0.320	0.300	0.271	0.361	0.336
7	0.420	0.365	0.558	0.748	0.563	0.582	0.511	0.446	0.447	0.386	0.361	0.309	0.313	0.254
8	0.504	0.616	0.758	0.678	0.575	0.564	0.510	0.433	0.406	0.382	0.411	0.422	0.313	0.253
9	0.612	0.717	0.603	0.630	0.504	0.567	0.548	0.485	0.469	0.456	0.395	0.338	0.353	0.274
10	0.842	0.792	0.626	0.625	0.529	0.519	0.621	0.529	0.475	0.438	0.466	0.371	0.391	0.269
11	0.856	0.745	0.684	0.762	0.605	0.648	0.688	0.638	0.647	0.533	0.523	0.458	0.488	0.372
12	1.279	1.094	0.954	0.943	0.768	0.758	0.790	0.737	0.808	0.750	0.664	0.588	0.635	0.393
W3	1.217	1.078	0.877	0.874	0.850	0.873	0.829	0.900	0.722	0.678	0.656	0.601	0.611	0.385
W4	1.020	0.935	0.848	0.798	0.724	0.723	0.670	0.591	0.585	0.533	0.535	0.450	0.392	0.298

Table A6(c) Minimum Pressure Coefficients Referenced To Eaves Height, θ = 75 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-1.802	-1.778	-1.301	-0.945	-0.793	-0.727	-0.553	-0.574	-0.548	-0.424	-0.379	-0.329	-0.337	-0.339
W2	-1.636	-1.326	-1.096	-1.181	-1.021	-0.967	-0.711	-0.705	-0.627	-0.520	-0.514	-0.528	-0.453	-0.427
1	-1.321	-1.246	-1.062	-1.057	-1.010	-1.138	-0.615	-0.560	-0.512	-0.415	-0.395	-0.340	-0.353	-0.348
2	-3.471	-2.224	-1.868	-1.577	-1.323	-1.261	-0.696	-0.732	-0.828	-0.689	-0.587	-0.499	-0.560	-0.464
3	-3.531	-2.169	-1.835	-1.298	-0.894	-0.770	-0.541	-0.772	-0.562	-0.499	-0.636	-0.570	-0.537	-0.452
4	-2.675	-2.237	-1.443	-1.117	-0.868	-0.500	-0.794	-0.881	-0.715	-0.853	-0.838	-0.809	-0.708	-0.594
5	-3.039	-2.349	-2.065	-1.237	-1.174	-1.255	-1.088	-1.200	-1.227	-1.087	-1.020	-0.924	-0.767	-0.602
6	-3.475	-2.724	-2.686	-2.251	-1.742	-1.730	-1.362	-1.481	-1.368	-1.310	-1.133	-1.040	-1.113	-1.052
7	-3.226	-2.386	-1.633	-1.330	-0.947	-0.843	-0.746	-0.692	-0.611	-0.581	-0.628	-0.543	-0.604	-0.505
8	-3.026	-2.211	-1.501	-0.949	-0.678	-0.453	-0.500	-0.501	-0.412	-0.413	-0.498	-0.521	-0.430	-0.335
9	-3.000	-2.190	-1.436	-0.932	-0.563	-0.528	-0.400	-0.440	-0.529	-0.441	-0.397	-0.351	-0.433	-0.331
10	-3.810	-1.988	-1.168	-1.001	-0.615	-0.515	-0.457	-0.592	-0.515	-0.514	-0.538	-0.451	-0.458	-0.403
11	-3.380	-2.112	-1.271	-1.289	-1.121	-1.336	-1.223	-1.272	-1.198	-1.011	-1.036	-0.917	-1.051	-0.766
12	-1.605	-1.367	-0.983	-0.813	-0.546	-0.469	-0.394	-0.404	-0.335	-0.332	-0.309	-0.318	-0.358	-0.321
W3	-1.711	-1.560	-1.230	-1.308	-0.751	-0.595	-0.391	-0.346	-0.334	-0.334	-0.337	-0.324	-0.323	-0.331
W4	-2.135	-1.663	-0.836	-0.543	-0.427	-0.291	-0.201	-0.272	-0.346	-0.305	-0.295	-0.273	-0.269	-0.308

Table A6(d) Standard Deviation Pressure Coefficients Referenced To Eaves Height, θ = 75 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.163	0.169	0.142	0.130	0.110	0.107	0.095	0.097	0.096	0.087	0.083	0.076	0.079	0.072
W2	0.146	0.152	0.145	0.142	0.122	0.122	0.104	0.105	0.103	0.093	0.085	0.077	0.079	0.075
1	0.139	0.147	0.134	0.134	0.131	0.146	0.097	0.098	0.096	0.087	0.080	0.074	0.075	0.071
2	0.372	0.267	0.215	0.194	0.149	0.149	0.114	0.111	0.106	0.097	0.090	0.081	0.083	0.075
3	0.325	0.239	0.184	0.163	0.125	0.119	0.098	0.096	0.096	0.086	0.083	0.077	0.079	0.074
4	0.287	0.264	0.186	0.155	0.115	0.099	0.100	0.107	0.102	0.110	0.106	0.107	0.095	0.082
5	0.331	0.279	0.253	0.161	0.149	0.169	0.161	0.172	0.176	0.161	0.142	0.117	0.104	0.083
6	0.389	0.329	0.320	0.313	0.241	0.225	0.188	0.202	0.194	0.167	0.140	0.126	0.120	0.098
7	0.374	0.286	0.193	0.158	0.115	0.114	0.109	0.108	0.103	0.092	0.090	0.083	0.086	0.076
8	0.362	0.308	0.203	0.133	0.100	0.090	0.094	0.092	0.084	0.084	0.081	0.087	0.076	0.067
9	0.360	0.329	0.174	0.118	0.094	0.094	0.092	0.090	0.089	0.084	0.082	0.075	0.075	0.066
10	0.468	0.277	0.136	0.114	0.097	0.097	0.099	0.100	0.095	0.091	0.087	0.079	0.082	0.070
11	0.509	0.223	0.163	0.151	0.134	0.143	0.140	0.145	0.138	0.123	0.124	0.113	0.113	0.091
12	0.246	0.241	0.198	0.165	0.120	0.109	0.108	0.110	0.101	0.093	0.101	0.081	0.085	0.073
W3	0.270	0.262	0.211	0.176	0.128	0.119	0.109	0.109	0.104	0.096	0.092	0.085	0.084	0.072
W4	0.273	0.253	0.182	0.139	0.107	0.101	0.096	0.095	0.094	0.087	0.082	0.075	0.072	0.067

Table A7(a) Mean Pressure Coefficients Referenced To Ridge Height, θ = 90 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-0.310	-0.249	-0.118	-0.034	-0.003	0.018	0.043	0.039	0.061	0.060	0.036	0.043	0.021	-0.003
W2	-0.323	-0.265	-0.158	-0.088	-0.061	-0.007	0.017	0.020	0.034	0.031	0.008	0.021	0.006	-0.011
1	-0.270	-0.244	-0.134	-0.054	-0.039	0.011	0.044	0.034	0.030	0.017	0.028	0.038	0.025	0.033
2	-0.784	-0.321	-0.169	-0.082	-0.050	-0.022	0.008	-0.004	0.015	0.007	-0.004	0.015	0.000	-0.002
3	-0.796	-0.445	-0.146	-0.058	-0.030	-0.012	0.022	0.004	0.022	0.027	0.006	0.032	0.005	-0.001
4	-0.693	-0.568	-0.198	-0.061	-0.025	0.171	0.030	0.011	0.174	0.026	0.017	-0.016	0.004	0.001
5	-0.662	-0.552	-0.228	-0.071	-0.032	-0.006	0.021	-0.002	0.018	0.016	0.011	0.006	0.001	0.008
6	-0.688	-0.543	-0.258	-0.111	-0.064	-0.036	-0.003	-0.025	-0.007	-0.012	-0.001	0.028	-0.005	0.005
7	-0.684	-0.545	-0.258	-0.119	-0.081	-0.048	-0.017	-0.001	0.004	-0.001	-0.007	0.025	-0.007	0.004
8	-0.661	-0.550	-0.251	-0.090	-0.043	-0.012	0.010	0.015	0.019	0.016	0.018	-0.008	0.002	0.003
9	-0.660	-0.526	-0.218	-0.072	-0.034	-0.001	0.022	0.025	0.028	0.027	0.026	0.046	0.005	-0.001
10	-0.754	-0.426	-0.173	-0.074	-0.037	-0.002	0.021	0.022	0.031	0.030	0.030	0.050	0.009	-0.005
11	-0.674	-0.314	-0.188	-0.104	-0.059	-0.022	0.008	0.005	0.020	0.021	0.018	0.037	0.004	0.003
12	-0.214	-0.216	-0.163	-0.098	-0.041	0.009	0.045	0.035	0.062	0.056	0.036	0.060	0.027	0.012
W3	-0.236	-0.230	-0.169	-0.095	-0.048	-0.009	0.028	0.027	0.044	0.042	0.040	0.057	0.019	0.007
W4	-0.239	-0.224	-0.146	-0.071	-0.023	0.019	0.046	0.043	0.055	0.051	0.052	0.066	0.032	0.017

Table A7(b) Maximum Pressure Coefficients Referenced To Ridge Height, θ = 90 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.647	0.681	0.527	0.531	0.520	0.511	0.543	0.538	0.527	0.472	0.448	0.398	0.359	0.273
W2	0.497	0.556	0.622	0.615	0.513	0.626	0.497	0.505	0.550	0.479	0.416	0.398	0.401	0.317
1	0.557	0.577	0.508	0.530	0.489	0.655	0.475	0.442	0.497	0.412	0.477	0.410	0.375	0.342
2	0.322	0.461	0.446	0.540	0.439	0.533	0.493	0.458	0.489	0.405	0.408	0.393	0.388	0.304
3	0.299	0.332	0.399	0.550	0.438	0.521	0.428	0.444	0.430	0.385	0.363	0.367	0.376	0.307
4	0.291	0.381	0.555	0.626	0.450	0.560	0.469	0.472	0.554	0.406	0.394	0.315	0.339	0.288
5	0.184	0.293	0.546	0.633	0.539	0.584	0.454	0.458	0.478	0.391	0.406	0.369	0.375	0.337
6	0.248	0.403	0.536	0.698	0.599	0.565	0.480	0.507	0.486	0.413	0.436	0.424	0.393	0.362
7	0.227	0.398	0.621	0.770	0.536	0.572	0.556	0.529	0.574	0.442	0.454	0.466	0.379	0.336
8	0.301	0.398	0.605	0.659	0.508	0.444	0.544	0.516	0.426	0.431	0.464	0.436	0.390	0.328
9	0.329	0.381	0.482	0.605	0.478	0.490	0.506	0.483	0.435	0.391	0.393	0.371	0.370	0.316
10	0.398	0.466	0.411	0.563	0.433	0.485	0.470	0.530	0.459	0.410	0.419	0.391	0.347	0.276
11	0.434	0.550	0.438	0.561	0.528	0.574	0.541	0.503	0.537	0.458	0.425	0.409	0.420	0.343
12	0.665	0.646	0.593	0.614	0.489	0.546	0.549	0.534	0.523	0.455	0.440	0.403	0.363	0.276
W3	0.728	0.687	0.608	0.716	0.544	0.540	0.541	0.527	0.520	0.467	0.458	0.400	0.386	0.309
W4	0.740	0.687	0.505	0.593	0.467	0.567	0.518	0.520	0.496	0.438	0.457	0.403	0.373	0.308

Table A7(c) Minimum Pressure Coefficients Referenced To Ridge Height, θ = 90 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	-2.095	-1.762	-1.011	-0.797	-0.502	-0.517	-0.409	-0.345	-0.342	-0.267	-0.312	-0.287	-0.299	-0.310
W2	-1.848	-1.508	-1.308	-1.167	-0.920	-0.793	-0.682	-0.549	-0.516	-0.509	-0.469	-0.418	-0.529	-0.423
1	-1.329	-1.314	-1.085	-0.844	-0.843	-0.939	-0.407	-0.440	-0.472	-0.388	-0.393	-0.343	-0.425	-0.411
2	-3.575	-2.239	-1.776	-1.470	-0.936	-0.951	-0.671	-0.790	-0.760	-0.609	-0.689	-0.648	-0.767	-0.567
3	-3.555	-2.264	-1.658	-1.180	-0.721	-0.594	-0.446	-0.490	-0.519	-0.424	-0.457	-0.369	-0.421	-0.369
4	-2.972	-2.286	-1.247	-1.071	-0.663	-0.338	-0.435	-0.445	-0.251	-0.407	-0.445	-0.418	-0.398	-0.363
5	-2.864	-2.110	-1.432	-1.088	-0.711	-0.685	-0.600	-0.653	-0.660	-0.597	-0.616	-0.568	-0.484	-0.369
6	-3.136	-2.529	-1.618	-1.449	-1.220	-1.065	-0.853	-0.868	-0.873	-0.774	-0.781	-0.717	-0.605	-0.449
7	-3.147	-2.336	-1.802	-1.755	-1.473	-1.317	-1.063	-0.921	-0.824	-0.676	-0.789	-0.705	-0.593	-0.431
8	-3.130	-2.341	-1.568	-1.283	-0.893	-0.706	-0.636	-0.596	-0.548	-0.555	-0.539	-0.516	-0.421	-0.369
9	-2.852	-2.259	-1.388	-0.963	-0.667	-0.550	-0.548	-0.548	-0.433	-0.361	-0.393	-0.331	-0.456	-0.334
10	-3.490	-2.059	-1.212	-1.089	-0.839	-0.634	-0.541	-0.514	-0.420	-0.412	-0.437	-0.365	-0.420	-0.350
11	-3.565	-2.373	-1.615	-1.385	-1.075	-0.878	-0.901	-0.867	-0.760	-0.668	-0.667	-0.533	-0.675	-0.499
12	-1.669	-1.327	-1.167	-0.963	-0.773	-0.720	-0.609	-0.438	-0.456	-0.412	-0.365	-0.300	-0.357	-0.289
W3	-1.583	-1.450	-1.304	-1.185	-0.840	-0.707	-0.651	-0.632	-0.607	-0.501	-0.476	-0.374	-0.457	-0.396
W4	-1.896	-1.696	-1.092	-0.797	-0.595	-0.523	-0.430	-0.419	-0.396	-0.343	-0.317	-0.299	-0.298	-0.276

Table A7(d) Standard Deviation Pressure Coefficients Referenced To Ridge Height, θ = 90 Degrees

Panel	Truss Reference													
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N
W1	0.238	0.231	0.168	0.138	0.105	0.097	0.085	0.084	0.085	0.076	0.077	0.072	0.070	0.065
W2	0.215	0.214	0.189	0.175	0.130	0.118	0.095	0.094	0.092	0.084	0.084	0.077	0.077	0.071
1	0.189	0.195	0.167	0.150	0.120	0.126	0.091	0.087	0.085	0.080	0.080	0.075	0.073	0.071
2	0.424	0.247	0.192	0.165	0.117	0.121	0.103	0.104	0.102	0.090	0.093	0.086	0.087	0.076
3	0.383	0.252	0.175	0.138	0.102	0.098	0.083	0.084	0.088	0.079	0.080	0.076	0.076	0.071
4	0.324	0.283	0.179	0.141	0.101	0.086	0.085	0.086	0.077	0.077	0.080	0.075	0.072	0.068
5	0.323	0.280	0.198	0.143	0.108	0.109	0.092	0.091	0.096	0.085	0.086	0.082	0.081	0.070
6	0.354	0.295	0.216	0.186	0.143	0.137	0.114	0.116	0.119	0.106	0.101	0.089	0.089	0.077
7	0.359	0.298	0.217	0.195	0.159	0.151	0.131	0.115	0.110	0.096	0.100	0.090	0.089	0.077
8	0.324	0.283	0.207	0.157	0.119	0.103	0.105	0.098	0.088	0.085	0.088	0.085	0.081	0.070
9	0.323	0.282	0.187	0.143	0.111	0.104	0.096	0.090	0.086	0.079	0.081	0.075	0.076	0.067
10	0.380	0.258	0.177	0.148	0.114	0.103	0.099	0.092	0.086	0.080	0.083	0.076	0.076	0.069
11	0.404	0.258	0.198	0.175	0.141	0.132	0.118	0.109	0.104	0.090	0.094	0.086	0.088	0.077
12	0.177	0.186	0.178	0.163	0.127	0.112	0.108	0.094	0.088	0.080	0.082	0.072	0.074	0.067
W3	0.190	0.202	0.182	0.171	0.133	0.119	0.106	0.098	0.092	0.082	0.080	0.075	0.076	0.069
W4	0.207	0.210	0.161	0.136	0.114	0.104	0.095	0.091	0.086	0.078	0.077	0.072	0.072	0.068

Appendix B Analysis of Truss Using SPACE GASS

SPACE GASS 7.05b(Acd) - ACADEMIC VERSION ONLY - NOT FOR COMMERCIAL USE
Job name: THESIS Designer: BJW Date: 30 Jan 1998, 5:05 pm Page: 1
Thesis Frame Analysis
Thesis Frame Analysis

ANALYSIS STATUS REPORT

Job	C:\SGWIN\DATA\THESIS	
Units system	Newtons, Millimetres	
Nodes	9	(100)
Members	13	(100)
Restrained nodes	4	(100)
Nodes with spring restraints	0	(100)
Section properties	4	(10)
Material properties	1	(2)
Constrained nodes	0	(100)
Node loads	0	(1000)
Prescribed node displacements	0	(1000)
Member concentrated loads	10	(1000)
Member distributed forces	0	(1000)
Member distributed torsions	0	(1000)
Thermal/Prestress loads	0	(1000)
Self weight load cases	0	(10)
Combination load cases	0	(10)
Load cases with titles	0	(10)
Lumped masses	0	(1000)
Static analysis	Y	
Dynamic analysis	N	
Buckling analysis	N	
Ill-conditioned	N	
Non-linear convergence	Y	
Frontwidth	16	
Total degrees of freedom	23	
Primary load cases	10	(10)
Mass load cases	0	(10)

NODE COORDINATES (mm)

Node	X Coord	Y Coord	Z Coord
1	0.00	0.00	0.00
2	611.00	222.00	0.00
3	2537.00	923.00	0.00
4	3031.00	222.00	0.00
5	4360.00	1587.00	0.00
6	5691.00	222.00	0.00
7	6183.00	923.00	0.00
8	8111.00	222.00	0.00
9	8722.00	0.00	0.00

MEMBER DATA (deg,mm,N/mm,Nmm/rad)
----------- (F=Fixed, R=Released)

Memb	Skew Angle	Type	Node A	Node B	Sec	Mat	Node A Fixity	Node B Fixity	Rigid End A	Rigid End B	Length
1	0.0	N	1	2	1	1	FFFFFF	FFFFFF	0.00	0.00	650.081
2	0.0	N	2	3	1	1	FFFFFF	FFFFFF	0.00	0.00	2049.604
3	0.0	N	3	5	1	1	FFFFFF	FFFFFF	0.00	0.00	1940.161
4	0.0	N	5	7	1	1	FFFFFF	FFFFFF	0.00	0.00	1940.161
5	0.0	N	7	8	1	1	FFFFFF	FFFFFF	0.00	0.00	2051.484
6	0.0	N	8	9	1	1	FFFFFF	FFFFFF	0.00	0.00	650.081
7	0.0	N	2	4	2	1	FFFFFF	FFFFFF	0.00	0.00	2420.000
8	0.0	N	4	6	2	1	FFFFFF	FFFFFF	0.00	0.00	2660.000
9	0.0	N	6	8	2	1	FFFFFF	FFFFFF	0.00	0.00	2420.000
10	0.0	N	3	4	3	1	FFFFFR	FFFFFR	0.00	0.00	857.576
11	0.0	N	4	5	3	1	FFFFFR	FFFFFR	0.00	0.00	1905.116
12	0.0	N	5	6	3	1	FFFFFR	FFFFFR	0.00	0.00	1906.511
13	0.0	N	6	7	3	1	FFFFFR	FFFFFR	0.00	0.00	856.426

NODE RESTRAINTS (N/mm,Nmm/rad)
--------------- (F=Fixed, R=Released, D=Deleted, S=Spring, *=General)

Node	Rest Code	X Axial Stiffness	Y Axial Stiffness	Z Axial Stiffness	X Rotation Stiffness	Y Rotation Stiffness	Z Rotation Stiffness
1	RRDDDR						
2	FFDDDR						
3	RRDDDR*						
8	FFDDDR						
9	RRDDDR						

SECTION PROPERTIES (mm,mm^2,mm^4,deg)

Sect	Section Name	Mark	Angle Type	Flipped	Source
1	Z 101x47x1.0	S1	Not applicable	No	Manual
2	Z 101x47x1.0	S2	Not applicable	No	Manual
3	C 75x32x1.2	S3	Not applicable	No	Manual
4	610 UB 125	S4	Not applicable	No	AUSTNEW.LSS

Sect	Area of Section	Torsion Constant	Y-Axis Mom of In	Z-Axis Mom of In	Y-Axis Shr Area	Z-Axis Shr Area	Princ Angle
1	2.1500E+02	7.1700E+01	4.3000E+04	4.4800E+05	INFINITE	INFINITE	0.00
2	2.1500E+02	7.1700E+01	4.3000E+04	4.4800E+05	INFINITE	INFINITE	0.00
3	2.1500E+02	7.1700E+01	7.5000E+04	3.6100E+05	INFINITE	INFINITE	0.00
4	1.6000E+04	1.5500E+06	3.9300E+07	9.8600E+08	INFINITE	INFINITE	0.00

MATERIAL PROPERTIES (MPa,Kg/mm^3)

Matl	Material Name	Young's Modulus	Poisson's Ratio	Mass Density	Coeff of Expansion	Concrete Strength
1	STEEL	2.0000E+05	0.25	7.8500E-06	1.1700E-05	

MEMBER CONCENTRATED LOADS (mm,N,Nmm)

Load Case	Memb	Sub Load	Axes Sys	Load Position	X Force/ Moment	Y Force/ Moment	Z Force/ Moment
1	1	1	L	75.00	0.00	1.00	0.00
					0.00	0.00	0.00
2	1	1	L	75.00	0.00	-1.00	0.00
					0.00	0.00	0.00
3	2	1	L	325.00	0.00	-1.00	0.00
					0.00	0.00	0.00
4	2	1	L	1635.00	0.00	-1.00	0.00
					0.00	0.00	0.00
5	3	1	L	895.00	0.00	-1.00	0.00
					0.00	0.00	0.00
6	3	1	L	1795.00	0.00	-1.00	0.00
					0.00	0.00	0.00
7	4	1	L	140.00	0.00	-1.00	0.00
					0.00	0.00	0.00
8	4	1	L	1040.00	0.00	-1.00	0.00
					0.00	0.00	0.00
9	5	1	L	410.00	0.00	-1.00	0.00
					0.00	0.00	0.00
10	5	1	L	1720.00	0.00	-1.00	0.00
					0.00	0.00	0.00

This academic version of SPACE GASS must not be used for commercial purposes

MEMBER FORCES AND MOMENTS (N,Nmm)

Load case 1 (Linear):

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	1.00	0.00	0.00	0.00	575.08
2	2	0.69	-0.19	0.00	0.00	0.00	311.43
	3	0.69	-0.19	0.00	0.00	0.00	-75.67
3	3	0.62	0.05	0.00	0.00	0.00	-75.67
	5	0.62	0.05	0.00	0.00	0.00	19.10
4	5	0.21	-0.01	0.00	0.00	0.00	19.10
	7	0.21	-0.01	0.00	0.00	0.00	-5.60
5	7	0.21	0.01	0.00	0.00	0.00	-5.60
	8	0.21	0.01	0.00	0.00	0.00	6.01
6	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
7	2	-0.34	-0.13	0.00	0.00	0.00	263.65
	4	-0.34	-0.13	0.00	0.00	0.00	-61.09
8	4	0.16	0.03	0.00	0.00	0.00	-61.09
	6	0.16	0.03	0.00	0.00	0.00	17.20
9	6	0.17	-0.01	0.00	0.00	0.00	17.20
	8	0.17	-0.01	0.00	0.00	0.00	-6.01
10	3	0.25	0.00	0.00	0.00	0.00	0.00
	4	0.25	0.00	0.00	0.00	0.00	0.00
11	4	-0.51	0.00	0.00	0.00	0.00	0.00
	5	-0.51	0.00	0.00	0.00	0.00	0.00
12	5	0.03	0.00	0.00	0.00	0.00	0.00
	6	0.03	0.00	0.00	0.00	0.00	0.00
13	6	0.02	0.00	0.00	0.00	0.00	0.00
	7	0.02	0.00	0.00	0.00	0.00	0.00

Load case 2 (Linear):

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	-1.00	0.00	0.00	0.00	-575.08
2	2	-0.69	0.19	0.00	0.00	0.00	-311.43
	3	-0.69	0.19	0.00	0.00	0.00	75.67
3	3	-0.62	-0.05	0.00	0.00	0.00	75.67
	5	-0.62	-0.05	0.00	0.00	0.00	-19.10
4	5	-0.21	0.01	0.00	0.00	0.00	-19.10
	7	-0.21	0.01	0.00	0.00	0.00	5.60
5	7	-0.21	-0.01	0.00	0.00	0.00	5.60
	8	-0.21	-0.01	0.00	0.00	0.00	-6.01
6	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
7	2	0.34	0.13	0.00	0.00	0.00	-263.65
	4	0.34	0.13	0.00	0.00	0.00	61.09
8	4	-0.16	-0.03	0.00	0.00	0.00	61.09
	6	-0.16	-0.03	0.00	0.00	0.00	-17.20
9	6	-0.17	0.01	0.00	0.00	0.00	-17.20
	8	-0.17	0.01	0.00	0.00	0.00	6.01
10	3	-0.25	0.00	0.00	0.00	0.00	0.00
	4	-0.25	0.00	0.00	0.00	0.00	0.00
11	4	0.51	0.00	0.00	0.00	0.00	0.00
	5	0.51	0.00	0.00	0.00	0.00	0.00
12	5	-0.03	0.00	0.00	0.00	0.00	0.00
	6	-0.03	0.00	0.00	0.00	0.00	0.00
13	6	-0.02	0.00	0.00	0.00	0.00	0.00
	7	-0.02	0.00	0.00	0.00	0.00	0.00

SPACE GASS 7.05b(Acd) - ACADEMIC VERSION ONLY - NOT FOR COMMERCIAL USE
Job name: THESIS Designer: BJW Date: 30 Jan 1998, 5:06 pm Page: 2
Thesis Frame Analysis
Thesis Frame Analysis

Load case 3 (Linear):

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
2	2	0.39	0.87	0.00	0.00	0.00	-110.95
	3	0.39	-0.13	0.00	0.00	0.00	-50.84
3	3	0.35	0.03	0.00	0.00	0.00	-50.84
	5	0.35	0.03	0.00	0.00	0.00	12.82
4	5	0.12	-0.01	0.00	0.00	0.00	12.82
	7	0.12	-0.01	0.00	0.00	0.00	-3.42
5	7	0.12	0.00	0.00	0.00	0.00	-3.42
	8	0.12	0.00	0.00	0.00	0.00	2.73
6	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
7	2	-0.20	-0.06	0.00	0.00	0.00	110.95
	4	-0.20	-0.06	0.00	0.00	0.00	-24.76
8	4	0.10	0.01	0.00	0.00	0.00	-24.76
	6	0.10	0.01	0.00	0.00	0.00	7.04
9	6	0.10	0.00	0.00	0.00	0.00	7.04
	8	0.10	0.00	0.00	0.00	0.00	-2.73
10	3	0.17	0.00	0.00	0.00	0.00	0.00
	4	0.17	0.00	0.00	0.00	0.00	0.00
11	4	-0.29	0.00	0.00	0.00	0.00	0.00
	5	-0.29	0.00	0.00	0.00	0.00	0.00
12	5	0.01	0.00	0.00	0.00	0.00	0.00
	6	0.01	0.00	0.00	0.00	0.00	0.00
13	6	0.01	0.00	0.00	0.00	0.00	0.00
	7	0.01	0.00	0.00	0.00	0.00	0.00

Load case 4 (Linear):

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
2	2	1.71	0.18	0.00	0.00	0.00	-65.99
	3	1.71	-0.82	0.00	0.00	0.00	-120.49
3	3	1.46	0.08	0.00	0.00	0.00	-120.49
	5	1.46	0.08	0.00	0.00	0.00	27.99
4	5	0.64	-0.02	0.00	0.00	0.00	27.99
	7	0.64	-0.02	0.00	0.00	0.00	-4.44
5	7	0.64	0.00	0.00	0.00	0.00	-4.44
	8	0.64	0.00	0.00	0.00	0.00	1.52
6	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
7	2	-0.88	-0.03	0.00	0.00	0.00	65.99
	4	-0.88	-0.03	0.00	0.00	0.00	-1.35
8	4	0.43	0.00	0.00	0.00	0.00	-1.35
	6	0.43	0.00	0.00	0.00	0.00	1.32
9	6	0.40	0.00	0.00	0.00	0.00	1.32
	8	0.40	0.00	0.00	0.00	0.00	-1.52
10	3	0.93	0.00	0.00	0.00	0.00	0.00
	4	0.93	0.00	0.00	0.00	0.00	0.00
11	4	-1.11	0.00	0.00	0.00	0.00	0.00
	5	-1.11	0.00	0.00	0.00	0.00	0.00
12	5	-0.02	0.00	0.00	0.00	0.00	0.00
	6	-0.02	0.00	0.00	0.00	0.00	0.00
13	6	0.02	0.00	0.00	0.00	0.00	0.00
	7	0.02	0.00	0.00	0.00	0.00	0.00

Load case 5 (Linear):

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
2	2	1.75	-0.08	0.00	0.00	0.00	34.97
	3	1.75	-0.08	0.00	0.00	0.00	-132.23
3	3	1.59	0.53	0.00	0.00	0.00	-132.23
	5	1.59	-0.47	0.00	0.00	0.00	-155.57
4	5	1.13	0.10	0.00	0.00	0.00	-155.57
	7	1.13	0.10	0.00	0.00	0.00	46.53
5	7	1.09	-0.03	0.00	0.00	0.00	46.53
	8	1.09	-0.03	0.00	0.00	0.00	-12.01
6	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
7	2	-0.62	0.02	0.00	0.00	0.00	-34.97
	4	-0.62	0.02	0.00	0.00	0.00	23.32
8	4	0.21	-0.01	0.00	0.00	0.00	23.32
	6	0.21	-0.01	0.00	0.00	0.00	-5.10
9	6	0.38	0.01	0.00	0.00	0.00	-5.10
	8	0.38	0.01	0.00	0.00	0.00	12.01
10	3	0.63	0.00	0.00	0.00	0.00	0.00
	4	0.63	0.00	0.00	0.00	0.00	0.00
11	4	-0.67	0.00	0.00	0.00	0.00	0.00
	5	-0.67	0.00	0.00	0.00	0.00	0.00
12	5	0.13	0.00	0.00	0.00	0.00	0.00
	6	0.13	0.00	0.00	0.00	0.00	0.00
13	6	-0.14	0.00	0.00	0.00	0.00	0.00
	7	-0.14	0.00	0.00	0.00	0.00	0.00

Load case 6 (Linear):

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
2	2	1.25	-0.01	0.00	0.00	0.00	3.59
	3	1.25	-0.01	0.00	0.00	0.00	-9.38
3	3	1.24	0.04	0.00	0.00	0.00	-9.38
	5	1.24	-0.96	0.00	0.00	0.00	-68.09
4	5	1.47	0.05	0.00	0.00	0.00	-68.09
	7	1.47	0.05	0.00	0.00	0.00	28.23
5	7	1.46	-0.02	0.00	0.00	0.00	28.23
	8	1.46	-0.02	0.00	0.00	0.00	-5.58
6	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
7	2	-0.08	0.00	0.00	0.00	0.00	-3.59
	4	-0.08	0.00	0.00	0.00	0.00	7.46
8	4	-0.01	0.00	0.00	0.00	0.00	7.46
	6	-0.01	0.00	0.00	0.00	0.00	4.88
9	6	0.08	0.00	0.00	0.00	0.00	4.88
	8	0.08	0.00	0.00	0.00	0.00	5.58
10	3	0.05	0.00	0.00	0.00	0.00	0.00
	4	0.05	0.00	0.00	0.00	0.00	0.00
11	4	-0.05	0.00	0.00	0.00	0.00	0.00
	5	-0.05	0.00	0.00	0.00	0.00	0.00
12	5	0.08	0.00	0.00	0.00	0.00	0.00
	6	0.08	0.00	0.00	0.00	0.00	0.00
13	6	-0.07	0.00	0.00	0.00	0.00	0.00
	7	-0.07	0.00	0.00	0.00	0.00	0.00

Load case 7 (Linear):

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
2	2	1.46	0.02	0.00	0.00	0.00	-5.46
	3	1.46	0.02	0.00	0.00	0.00	27.75
3	3	1.48	-0.05	0.00	0.00	0.00	27.75
	5	1.48	-0.05	0.00	0.00	0.00	-66.13
4	5	1.24	0.96	0.00	0.00	0.00	-66.13
	7	1.24	-0.04	0.00	0.00	0.00	-8.60
5	7	1.25	0.01	0.00	0.00	0.00	-8.60
	8	1.25	0.01	0.00	0.00	0.00	3.40
6	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
7	2	0.08	0.00	0.00	0.00	0.00	5.46
	4	0.08	0.00	0.00	0.00	0.00	4.94
8	4	-0.01	0.00	0.00	0.00	0.00	4.94
	6	-0.01	0.00	0.00	0.00	0.00	7.38
9	6	-0.07	0.00	0.00	0.00	0.00	7.38
	8	-0.07	0.00	0.00	0.00	0.00	-3.40
10	3	-0.07	0.00	0.00	0.00	0.00	0.00
	4	-0.07	0.00	0.00	0.00	0.00	0.00
11	4	0.07	0.00	0.00	0.00	0.00	0.00
	5	0.07	0.00	0.00	0.00	0.00	0.00
12	5	-0.05	0.00	0.00	0.00	0.00	0.00
	6	-0.05	0.00	0.00	0.00	0.00	0.00
13	6	0.05	0.00	0.00	0.00	0.00	0.00
	7	0.05	0.00	0.00	0.00	0.00	0.00

Load case 8 (Linear):

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
2	2	1.09	0.03	0.00	0.00	0.00	-12.04
	3	1.09	0.03	0.00	0.00	0.00	46.70
3	3	1.13	-0.10	0.00	0.00	0.00	46.70
	5	1.13	-0.10	0.00	0.00	0.00	-156.16
4	5	1.59	0.48	0.00	0.00	0.00	-156.16
	7	1.59	-0.52	0.00	0.00	0.00	-131.86
5	7	1.75	0.08	0.00	0.00	0.00	-131.86
	8	1.75	0.08	0.00	0.00	0.00	34.91
6	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
7	2	0.38	-0.01	0.00	0.00	0.00	12.04
	4	0.38	-0.01	0.00	0.00	0.00	-5.10
8	4	0.21	0.01	0.00	0.00	0.00	-5.10
	6	0.21	0.01	0.00	0.00	0.00	23.31
9	6	-0.62	-0.02	0.00	0.00	0.00	23.31
	8	-0.62	-0.02	0.00	0.00	0.00	-34.91
10	3	-0.14	0.00	0.00	0.00	0.00	0.00
	4	-0.14	0.00	0.00	0.00	0.00	0.00
11	4	0.13	0.00	0.00	0.00	0.00	0.00
	5	0.13	0.00	0.00	0.00	0.00	0.00
12	5	-0.67	0.00	0.00	0.00	0.00	0.00
	6	-0.67	0.00	0.00	0.00	0.00	0.00
13	6	0.63	0.00	0.00	0.00	0.00	0.00
	7	0.63	0.00	0.00	0.00	0.00	0.00

Load case 9 (Linear):

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
2	2	0.64	0.00	0.00	0.00	0.00	1.48
	3	0.64	0.00	0.00	0.00	0.00	-4.37
3	3	0.64	0.02	0.00	0.00	0.00	-4.37
	5	0.64	0.02	0.00	0.00	0.00	27.72
4	5	1.47	-0.08	0.00	0.00	0.00	27.72
	7	1.47	-0.08	0.00	0.00	0.00	-119.57
5	7	1.71	0.83	0.00	0.00	0.00	-119.57
	8	1.71	-0.17	0.00	0.00	0.00	-65.23
6	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
7	2	0.41	0.00	0.00	0.00	0.00	-1.48
	4	0.41	0.00	0.00	0.00	0.00	1.24
8	4	0.43	0.00	0.00	0.00	0.00	1.24
	6	0.43	0.00	0.00	0.00	0.00	-1.08
9	6	-0.88	0.03	0.00	0.00	0.00	-1.08
	8	-0.88	0.03	0.00	0.00	0.00	65.23
10	3	0.02	0.00	0.00	0.00	0.00	0.00
	4	0.02	0.00	0.00	0.00	0.00	0.00
11	4	-0.02	0.00	0.00	0.00	0.00	0.00
	5	-0.02	0.00	0.00	0.00	0.00	0.00
12	5	-1.11	0.00	0.00	0.00	0.00	0.00
	6	-1.11	0.00	0.00	0.00	0.00	0.00
13	6	0.94	0.00	0.00	0.00	0.00	0.00
	7	0.94	0.00	0.00	0.00	0.00	0.00

Load case 10 (Linear):

Memb	Node	Axial Force	Y-Axis Shear	Z-Axis Shear	X-Axis Torsion	Y-Axis Moment	Z-Axis Moment
1	1	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00
2	2	0.13	0.00	0.00	0.00	0.00	2.77
	3	0.13	0.00	0.00	0.00	0.00	-3.50
3	3	0.12	0.01	0.00	0.00	0.00	-3.50
	5	0.12	0.01	0.00	0.00	0.00	13.10
4	5	0.36	-0.03	0.00	0.00	0.00	13.10
	7	0.36	-0.03	0.00	0.00	0.00	-51.96
5	7	0.40	0.13	0.00	0.00	0.00	-51.96
	8	0.40	-0.87	0.00	0.00	0.00	-112.53
6	8	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00
7	2	0.10	0.00	0.00	0.00	0.00	-2.77
	4	0.10	0.00	0.00	0.00	0.00	7.13
8	4	0.10	-0.01	0.00	0.00	0.00	7.13
	6	0.10	-0.01	0.00	0.00	0.00	-25.08
9	6	-0.20	0.06	0.00	0.00	0.00	-25.08
	8	-0.20	0.06	0.00	0.00	0.00	112.53
10	3	0.01	0.00	0.00	0.00	0.00	0.00
	4	0.01	0.00	0.00	0.00	0.00	0.00
11	4	0.01	0.00	0.00	0.00	0.00	0.00
	5	0.01	0.00	0.00	0.00	0.00	0.00
12	5	-0.29	0.00	0.00	0.00	0.00	0.00
	6	-0.29	0.00	0.00	0.00	0.00	0.00
13	6	0.17	0.00	0.00	0.00	0.00	0.00
	7	0.17	0.00	0.00	0.00	0.00	0.00

NODE REACTIONS (N,Nmm)

Load case 1 (Linear):

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
2	0.71	-1.02	0.00	0.00	0.00	0.00
8	-0.37	0.08	0.00	0.00	0.00	0.00
Load	-0.34	0.94	0.00			
Reac	0.34	-0.94	0.00			

Load case 2 (Linear):

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
2	-0.71	1.02	0.00	0.00	0.00	0.00
8	0.37	-0.08	0.00	0.00	0.00	0.00
Load	0.34	-0.94	0.00			
Reac	-0.34	0.94	0.00			

Load case 3 (Linear):

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
2	-0.13	0.90	0.00	0.00	0.00	0.00
8	-0.21	0.04	0.00	0.00	0.00	0.00
Load	0.34	-0.94	0.00			
Reac	-0.34	0.94	0.00			

Load case 4 (Linear):

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
2	0.67	0.72	0.00	0.00	0.00	0.00
8	-1.01	0.22	0.00	0.00	0.00	0.00
Load	0.34	-0.94	0.00			
Reac	-0.34	0.94	0.00			

Load case 5 (Linear):

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
2	1.06	0.55	0.00	0.00	0.00	0.00
8	-1.40	0.39	0.00	0.00	0.00	0.00
Load	0.34	-0.94	0.00			
Reac	-0.34	0.94	0.00			

Load case 6 (Linear):

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
2	1.10	0.43	0.00	0.00	0.00	0.00
8	-1.45	0.51	0.00	0.00	0.00	0.00
Load	0.34	-0.94	0.00			
Reac	-0.34	0.94	0.00			

Load case 7 (Linear):

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
2	1.45	0.51	0.00	0.00	0.00	0.00
8	-1.10	0.43	0.00	0.00	0.00	0.00
Load	-0.34	-0.94	0.00			
Reac	0.34	0.94	0.00			

Load case 8 (Linear):

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
2	1.40	0.39	0.00	0.00	0.00	0.00
8	-1.06	0.55	0.00	0.00	0.00	0.00
Load	-0.34	-0.94	0.00			
Reac	0.34	0.94	0.00			

Load case 9 (Linear):

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
2	1.01	0.22	0.00	0.00	0.00	0.00
8	-0.67	0.72	0.00	0.00	0.00	0.00
Load	-0.34	-0.94	0.00			
Reac	0.34	0.94	0.00			

Load case 10 (Linear):

Node	X-Axis Force	Y-Axis Force	Z-Axis Force	X-Axis Moment	Y-Axis Moment	Z-Axis Moment
2	0.22	0.04	0.00	0.00	0.00	0.00
8	0.13	0.90	0.00	0.00	0.00	0.00
Load	-0.34	-0.94	0.00			
Reac	0.34	0.94	0.00			