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San Jose, California

08-164-0102

PROJECT GENSAP VERIFICATION FILE NO. _____
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GENSAP VERIFICATION

SUPPLEMENT "A"

(example problem #4)
"GRID FRAME"

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PDR ADDCK 05000313
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1.0 REFERENCES:

1. GENSAP User Information Manual
 Publication No: 86619900, Control Data Corp;
 Rev. C; June 1977
2. STARDYNE User Information Manual,
 Publication No: 76079900; Control Data Corp;
 Rev. C; April, 1980
3. STARDYNE Theoretical Manual, Static
 and Dynamic Analysis System;
 Publication No: 86616300; Control Data Corp;
 Rev. A; January 1974.
4. Computer runs associated with this
 verification process (Refer Pg.)
5. Raymond J. Roark and Warren C. Young;
 "Formulas for Stress and Strain", Fifth
 Edition 1975; McGraw Hill Book Co.

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2.0 GENSAP (VER. 3.1) VERIFICATION

SUPPLEMENT "A"

2.1 SCOPE: The scope of Supplement 'A' of GENSAP verification is as follows:

1. To verify the results based on GENSAP Ver. 3.1 against those based on STARDYNE, of the Grid Frame option of the GENSAP program containing Honey-comb sandwich panels and pressure, G and temperature loadings.
(GENSAP USER MANUAL EXAMPLE PROBLEM # 4)

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2.2 DESCRIPTION OF THE PROBLEM:

Example problem No: 4 from the GENSAP User Information Manual (B41) was chosen as the test problem. The details of the structure and the loadings imposed are given in pg. (4/64). Specimen comparison of the results based on GENSAP ver. 3.1 and STARDYNE are given in pages (8/64 to 13/64) & (28/64 to 33/64).

2.3 INFERENCE & COMMENTS: (GENERAL)

Marginal differences in the results based on GENSAP ver. 3.1 and STARDYNE were observed. The primary reason for these differences in results are due to the manner in which the imposed loads are internally applied by the program. These differences are tabulated in Pages (14/64) & (34/64). Detailed descriptions on the results are given subsequently.

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3.4 EXAMPLE PROBLEM 4

The joint displacements, member stresses, and plate stresses are to be determined for the grid structure shown in Figure

17. The problem demonstrates the use of honeycomb plate elements and the plate pressure and plate temperature load capabilities.

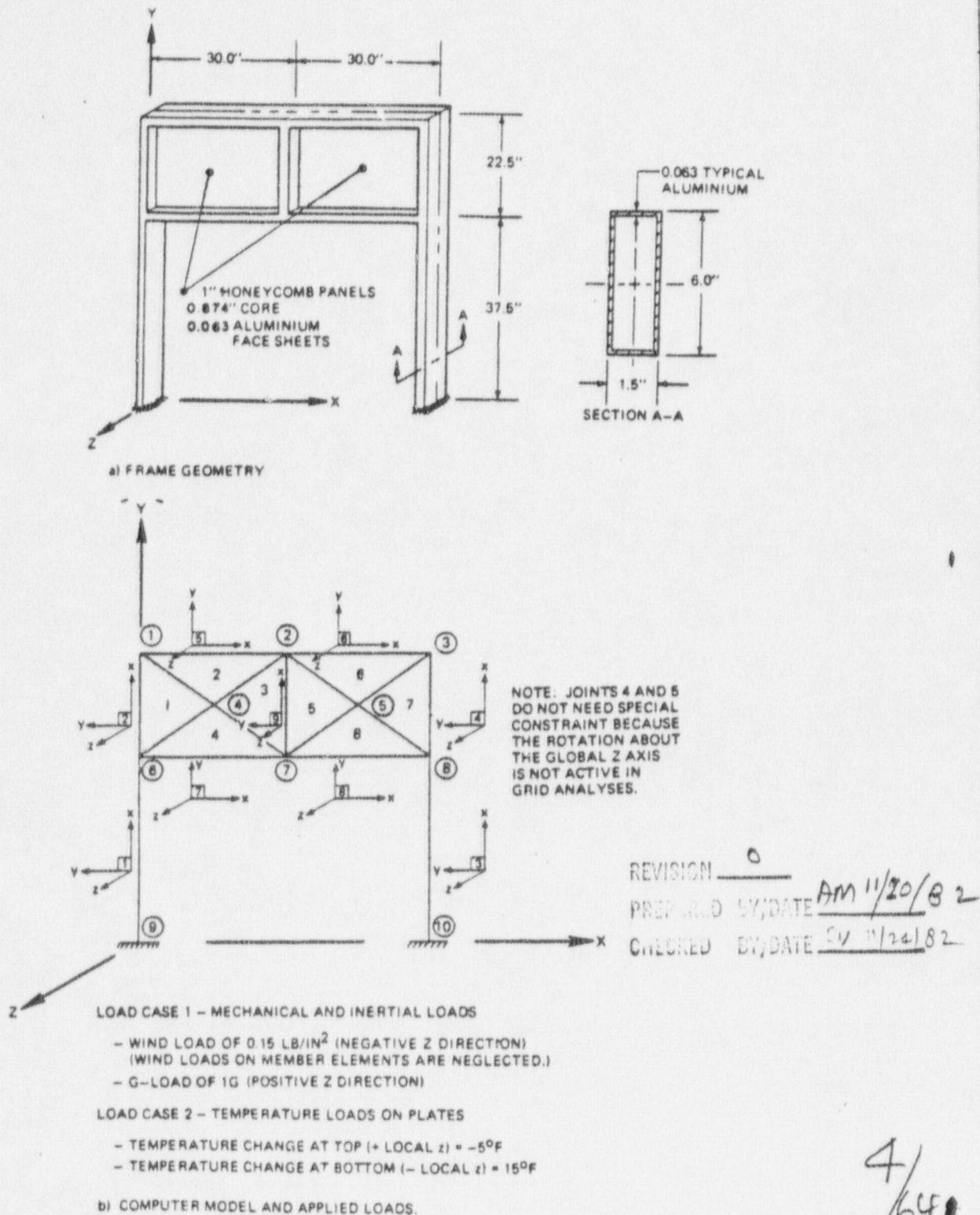


Figure 17. Grid Structure for Example Problem 4

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2.4. SUMMARY OF THE FINDINGS
AND PERTINENT RECOMMENDATIONS
ON THE USAGE OF GENSAP VER. 3.1
BASED ON THE VERIFICATION RESULTS
CONTAINED IN THE FOLLOWING PAGES OF
THIS PACKAGE:

1. The validity of the GENSAP Ver. 3.1 Computer Program is verified.
2. When g-loads and plate pressure loads are applied, it is suggested that the plate elements be modelled as quadrilateral as possible for better accuracy. User's description is required in this regard.
3. GENSAP Ver. 3.1 considers the centroidal temperature in the corner plates of honeycomb panels for the calculation of plate induced moments due to difference in temperature in the top and bottom surfaces of the honeycomb panels.

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4. GENSAP Ver 3.1 is also verified for the Grid frame case consisting of homogeneous plates instead of honey-comb panels.

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2.5. VERIFICATION OF GENSAP(Ver.3.1)

- ANALYSIS RESULTS

2.5.1 LOAD CASE NO: 1

(PRESSURE & G-LOADS).

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1
Subject: AND STARDYNE

STRUCTURE TYPE: GRID FRAME (L.CASE 1)					
NODAL DISPLACEMENTS (GLOBAL), INCHES					
NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	δ_z	-0.1096161	-0.1090406	=100%	
	θ_x	-0.0025896	-0.002566	~100%	
	θ_y	0.0002551	0.0002792	91%	
5	δ_z	-0.0841987	-0.084124	~100%	
	θ_x	-0.0024937	-0.002477	~100%	
	θ_y	-0.0001685	-0.0001844	93%	
7	δ_z	-0.0574036	-0.057551	~100%	
	θ_x	-0.0024748	-0.0024887	~100%	
	θ_y	0.0	0.0		

NOTE: Ref: Runs ① in Pg 63/64

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1

Subject: AND STARDYNE

STRUCTURE TYPE: GRID FRAME (L. CASE 1)

ELEMENT FORCES & MOMENTS (LBS & IN. LBS.)

ELSM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	9	F _z	80.5502	82.292	98%	
		M _x	-32.5441	-35.577	91	
		M _y	-4031.3510	-4031.350	100	
2	6	F _z	1.4316	2.328	61	
		M _x	-2.1856	-2.446	89	
		M _y	-399.8956	-379.533	105	
5	2	F _z	-2.1907	-0.747	293	
		M _x	16.6065	17.103	97	
		M _y	-354.4970	-378.381	94	

NOTES: Ref: Run ① in Pg. 68/64

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COMPARISON OF RESULTS BETWEEN GENSAP Ver. 3.1

Subject: AND STARDYNE

STRUCTURE TYPE:

GRID FRAME (L.CASE 1)

MEMBER STRESSES (psi)

ELEM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	9	f_y	-3186.2327	-3187.7	100%	
4	8	f_y	-316.1230	-300.11	105	
5	1	f_y	261.3345	-231.48	93	
8	7	f_y	262.3651	-233.37	94	

NOTES: Ref: Run ① in Pg 63/64

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME (L CASE #1)

PLATE CORNER FORCES (LBS.)

ELEM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	1	F _z	-26.1391	-32.578	Refer description in page	
		M _x	-15.3354	-6.517		
		M _y	355.7298	350.921		
	6	F _z	48.5044	42.308		
		M _x	57.9456	67.185		
		M _y	432.0137	439.428		
	4	F _z	0.8210	-9.732		
		M _x	61.0066	85.312		
		M _y	51.9952	52.092		
	7	F _z	-9.3062	-14.577		
		M _x	-22.4961	-11.274		
		M _y	241.9267	225.219		
8	8	F _z	35.0827	29.862		
		M _x	93.6460	105.900		
		M _y	295.8151	312.839		
	5	F _z	-2.5903	-15.035		
		M _x	44.9395	77.328		
		M _y	128.0911	128.522		

NOTES: Ref: Run ① in Pg 63/64

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1
AND STARDYNE

Subject: _____

STRUCTURE TYPE: GRID FRAME (L.CASE 1)

PLATE STRESSES (psi)

R# #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	ϕ (TOP)	-2.27	-2.417	Refer description in Page	
	σ_1	45.2055	40.74		
	σ_2	-14.8766	-19.88		
	τ_{max}	30.0411	30.31		
	ϕ (BOT)	87.73	87.583		
	σ_1	14.8766	19.88		
	σ_2	-45.2055	-40.74		
	τ_{max}	30.0411	30.31		
5	ϕ (TOP)	-0.27	-0.255		
	σ_1	-20.6069	-27.18		
	σ_2	-64.6033	-71.06		
	τ_{max}	21.9985	21.94		
	ϕ (BOT)	89.73	89.745		
	σ_1	64.6033	71.06		
	σ_2	20.6069	27.18		
	τ_{max}	21.9985	21.94		

NOTES: Ref: Run ϕ in Jy 63/64

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COMPARISON OF RESULTS BETWEEN GENSAP VER 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME (L.CASE 1)

SUPPORT REACTIONS (GLOBAL), LBS. & IN. LBS

NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
9	F _z	80.5502	80.550	100%	
	M _x	4031.3510	4031.350	100%	
	M _y	-32.5441	-35.577	91%	
10	F _z	80.5502	80.550	100%	
	M _x	4031.3510	4031.350	100%	
	M _y	32.5441	35.577	91%	

NOTES: Ref: Run ① in 12 63/64

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2.5.1.1

DIFFERENCES IN LOAD APPLICATION METHOD		ADAPTED BY GENSAP VER. 3.1 & STARDYNE	
GENSAP VER. 3.1	STARDYNE		
<u>L. CASE #1</u> (Pressure load & Inertial load). 1. Pressure loads in triangular plate elements are applied as equivalent nodal forces by equally distributing the total plate force to all the 3 nodes of each triangular element. 2. G-loads due to triangular plate elements are applied as equivalent nodal forces by equally distributing the total plate force to all the 3 nodes of each triangular element.		Pressure loads in triangular plate elements are applied as equivalent nodal forces proportionate to the angle contained by the triangular elements at those nodes. G-loads due to triangular plate elements are applied as equivalent nodal forces proportionate to the angle contained by the triangular elements at those nodes.	
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Case I: (Wind pressure loads & G-loads)

Refer to differences 1 & 2 in page (14/64). Distributing the plate loads proportionate to the angle contained by the triangular elements is more appropriate compared to distributing the loads equally to all 3 nodes of a triangular element. Hence Standyne results are more appropriate. However the difference in the results is not large and the accuracy can be improved by taking precautions while modeling so that the triangular elements are as equilateral as possible. However another alternate way to get more appropriate results using GENSAP is to apply the pressure & G-loads as externally applied nodal forces by pre-calculating the nodal forces proportionate to the angle contained by

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the triangular elements at each node. This alternate procedure yields GENSAP results which are in 100% agreement with STARDYNE as outlined in pages 20 to 25/64.

The analysis which supports the above, is described in the following pages.

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2.5.1.2

SUPPORTING ANALYSIS # 1:

Pressure and G-loaders on plates are applied internally by the GENIAP Program (ver 3.1) as equivalent nodal forces by equally dividing the plate load to the 3 corner nodes of the triangular element, as specified in Page 12 of Ref 1. But STARDYNE applies the nodal forces proportionate to the angle contained by the triangular element at those nodes, as specified in Page B2-95 of Ref. 2..

The above difference in the internal load application procedure between the two computer programs was therefore assumed to be responsible for the inconsistency in the results based on the two programs. To justify this understanding, the following analysis

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was performed.

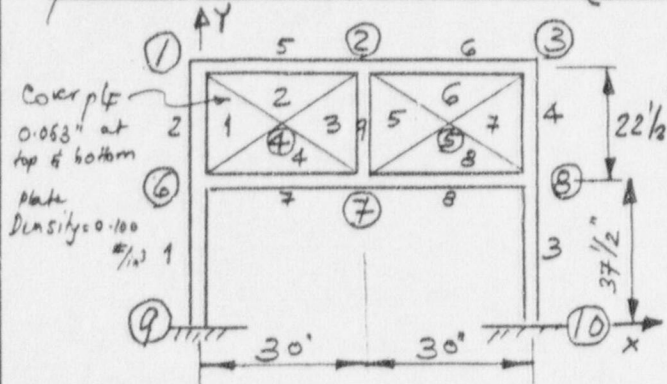
The problem was re-run using GENSAP Ver. 3.1 by applying the pressure and G-loads of Load Case 1, as equivalent nodal forces proportionate to the angle contained by the triangular element at each node. By doing so, the load application for Load Case 1 matches with that adopted by STARDYNE.

The calculation of the nodal forces and the summary of the analysis results comparison against STARDYNE results are shown in the following pages.

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Calculation of equivalent Nodal forces for L. Case 1 (Pressure & S-loads):



Total wind pr. load based on
1440° = $22.5 \times 60 \times 0.15 = 202.5 \#$
G-load due to plate based on
1440° = $2(0.063)60 \times 22.5 \times 0.100$
= $17.01 \#$
G-load due to members 1 & 3
= $37.5 \times 0.929124 \times 0.100 = 3.484 \#$
G-load due to members 5, 6, 7 & 8
= $30.0 \times 0.929124 \times 0.100 = 2.787 \#$
G-load due to members 2, 9 & 4
= $22.5 \times 0.929124 \times 0.100 = 2.091 \#$

NODE #	Wind pressure load on plates (0.15 #/in. - Z dirn)	G-load on the whole structure (+ Z dirn) plate	G-load on the member	Total nodal load (#)
1	$-\frac{40}{1440} \times 202.5 = -12.656 \#$	$\frac{90}{1440} \times 17.01 = 1.063$	$\frac{2.091}{2} + \frac{3.484}{2} = 2.439$	-9.154
2	$-\frac{180}{1440} \times 202.5 = -25.313 \#$	$\frac{180}{1440} \times 17.01 = 2.126$	$2.787 + \frac{2.091}{2} = 3.833$	-19.354
3	$= -12.656 \#$	$= 1.063$	$= 2.439$	-9.154
4	$-\frac{360}{1440} \times 202.5 = -50.625 \#$	$\frac{360}{1440} \times 17.01 = 4.252$	-	-46.373
5	$= -50.625 \#$	$= 4.252$	-	-46.373
6	$= -12.656 \#$	$= 1.063$	$\frac{2.091}{2} + \frac{3.484}{2} + \frac{2.787}{2} = 4.181$	-7.412
7	$= -25.313 \#$	$= 2.126$	$= 3.833$	-19.354
8	$= -12.656 \#$	$= 1.063$	$= 4.181$	-7.412
9	-	-	$\frac{3.484}{2} = 1.742$	1.742
10	-	-	1.742	1.742

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COMPARISON OF RESULTS BETWEEN GENSAP VER.3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME CASE 1

NODAL DISPLACEMENTS (GLOBAL)

NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	δ_z	-0.1090451	-0.1090406	$\approx 100\%$	
	θ_x	-0.0025664	-0.002566		
	θ_y	0.0002792	0.0002792		
5	δ_z	0.0841227	-0.084124		
	θ_x	-0.0024777	-0.002477		
	θ_y	-0.0001816	-0.00018144		
7	δ_z	-0.0575538	-0.057551		
	θ_x	-0.0024888	-0.0024887		
	θ_y	0.0	0.0		

NOTES: WITH EQUIV. NODAL FORCES PROPORTIONATE TO
 VERTEX ANGLE Ref: Run ② in Pg 63/64

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COMPARISON OF RESULTS BETWEEN GENSAP Ver. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME CASE 1

ELEMENT FORCES & MOMENTS (LBS & IN. LBS.) LOCAL COORD.

ELEM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	9	F _z	82.293	82.292	~100%	
		M _x	-35.5866	-35.577		
		M _y	-4031.3812	-4031.350		
2	6	F _z	2.4742	2.328		
		M _x	-2.4260	-2.446		
		M _y	-381.1974	-379.533		
5	2	F _z	-0.7947	-0.747		
		M _x	17.0831	17.103		
		M _y	-379.0815	-378.381	Y	

NOTES: WITH EQUIV. NODAL FORCES PROPORTIONATE TO
VERTER ANGLE, REF: RUNS (2) in Pg 63/64

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME CASE 1

MEMBER STRESSES (PSI)

ELSM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	9	f_y	-3186.8626	-3187.7	100%	
4	8	f_y	-301.3419	-300.11		
5	1	f_y	280.8236	-281.48		
8	7	f_y	283.6806	-283.37		

NOTES: WITH EQUIV. NODAL FORCES PROPORTIONATE TO
VERTICAL ANGLE; Ref. Run (2) in Page 63/64

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COMPARISON OF RESULTS BETWEEN GENSAP Ver. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME(CASE 1)

PLATE CORNER FORCES (LBS.)

ELEM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	1	F _z	-32.4288	-32.576	≈ 100% ↓ ✓	
		M _x	-6.4180	-6.517		
		M _y	349.3578	350.921		
	6	F _z	42.1614	42.308		
		M _x	67.1392	67.185		
		M _y	437.8255	439.428		
	4	F _z	-9.7327	-9.732		
		M _x	85.2686	85.312		
		M _y	51.9629	52.092		

NOTES: WITH EQUIV. NOCAL FORCES APPROPRIATE TO
VERTEX ANGLE; Ref Run @ in Pg. 63/64

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COMPARISON OF RESULTS BETWEEN GENSAP Ver. 3.1
AND STARDYNE

Subject: _____

STRUCTURE TYPE: TRID FRAME (L. CASE 1)

PLATE STRESSES (psi)

Pl #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	O (Top)	-2.44	-2.417	~100%	
	σ_1	40.7609	40.74		
	σ_2	-19.8341	-19.88		
	τ_{max}	30.2975	30.31		
	O (Bot)	87.56	87.583		
	σ_1	19.8341	19.88		
	σ_2	-40.7609	-40.74		
	τ_{max}	30.2975	30.31		

NOTES: WITH EQUIV. NODAL FORCES PROPORTIONATE TO
VERTEX ANGLE.; Ref runs ② in B 63/64

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COMPARISON OF RESULTS BETWEEN GENSAP VER 3.1

Subject: AND STARDYNE

STRUCTURE TYPE: GRID FRAME

C. CASE 1

SUPPORT REACTIONS (GLOBAL), LBS. & IN. LBS

NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
9	Fz	82.2930	80.550 *	100 % ↓ V	
	Mx	4031.3812	4031.350		
	My	-35.5866	-35.577		
10	Fz	82.2930	80.550 *		
	Mx	4031.3813	4031.350		
	My	35.5866	35.577		

NOTES: * Refer Page (61,62/64) for description.
WITH EQUIV. NODAL FORCES PROPORTIONATE TO
VERTEX ANGLE; See Run (2) in Page 63/64

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Inference:

The results based on the above run using GENSAP ver. 3.1 matched 100% with those based on STARDYNE, for Load Case 1.

This justifies the statements 1 and 2 in the table on page 14/64.

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Owner NUTECH _____
Client _____

2.5.2 LOAD CASE No: 2

(PLATE TEMPERATURE LOAD)

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Prepared By/Date	Am 11/20/82					of <u>64</u>
Checked By/Date	Ev 11/14/82					

COMPARISON OF RESULTS BETWEEN GENSAP VER.3.1
Subject: AND STARDYNE

STRUCTURE TYPE: GRID FRAME (L. CASE 2)

NODAL DISPLACEMENTS (GLOBAL), INCHES

NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	δ_z	0.0093237	0.0106015	88%	
	θ_x	0.0008286	0.00094216		
	θ_y	0.0007859	0.00089365		
5	δ_z	-0.0070924	-0.0080647		
	θ_x	0.0003908	0.00044435		
	θ_y	-0.0004882	-0.00055515		
7	δ_z	-0.0112480	-0.0127905		
	θ_x	-0.0003031	-0.0003446		
	θ_y	0.0	0.0		

NOTES: Ref. Para D in Pg 63/64

Revision	0					
Prepared By/Date	MM 11/20/82					
Checked By/Date	RV 11/20/82					

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COMPARISON OF RESULTS BETWEEN GENSAP Ver. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME (CASE #2)

ELEMENT FORCES & MOMENTS (LBS & IN. LBS.) LOCAL COORD.

ELEM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	9	F _z	0.0	-0.0	88%	
		M _x	-99.5662	-113.216		
		M _y	-0.0	0.0		
2	6	F _z	-0.0861	-0.092		
		M _x	-7.8687	-8.743		
		M _y	1454.0437	1653.271		
5	2	F _z	0.1585	0.169		
		M _x	42.4665	48.270		
		M _y	-1031.3173	-1172.837	Y	

NOTES: Rep: Runs ① in 03/6k

Revision	0					
Prepared By/Date	AM 11/10/82					
Checked By/Date	cy 11/10/82					

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COMPARISON OF RESULTS BETWEEN GENSAP Ver. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME (L.CASE #2)

MEMBER STRESSES (psi)

ELEM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	9	f_y	0.0	0.0		
4	8	f_y	1149.4416	1307.3	88%	
5	1	f_y	819.0295	931.4		
8	7	f_y	778.6560	885.74		

NOTES: Ref: Runs ① in Pg 63/64

Revision	0					
Prepared By/Date	AM 11/20/82					
Checked By/Date	EV 11/24/82					

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME (L. CASE 2)

PLATE CORNER FORCES (LBS.)

ELEM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	1	F _z	2.5237	2.884	88%	
		M _x	556.8784	683.261		
		M _y	-720.5027	-819.344		
	6	F _z	0.7723	0.874		
		M _x	565.9018	643.530		
		M _y	701.8120	797.950		
	4	F _z	-3.3009	-3.759		
		M _x	-1073.2660	-1220.411		
		M _y	-1.0686	-1.220		
	7	F _z	1.4404	1.650		
		M _x	643.7429	731.902		
		M _y	-555.3137	-631.616		
8	8	F _z	-.5597	-.647	V	
		M _x	701.9497	793.166		
		M _y	514.5917	584.767		
	5	F _z	-.8803	-1.003		
		M _x	-1335.7890	-1515.734		
		M _y	10.7199	12.173		
		F _z				
		M _x				
		M _y				

NOTES: Ref. Para ① in 8 63/64

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Prepared By/Date	AM/11-20-82					
Checked By/Date	CV 11-20-82					

COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME (CASE #2)

PLATE STRESSES (psi)

Ref #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	O (Top)	-85.08	-85.085		
	σ_1	1762.2024	1739.0	101%	*
	σ_2	1693.4601	1655.0	102%	
	τ_{max}	36.8712	41.92	88%	
	O (Bot)	1.72	4.915		
	σ_1	-1693.4601	-1655.0	102%	*
	σ_2	-1762.2024	-1739.0	101%	
	τ_{max}	36.8712	41.92	88%	
5	O (Top)	90.0	89.997		
	σ_1	1639.7070	1600.0	102%	*
	σ_2	1523.1840	1467.0	104%	
	τ_{max}	58.2615	66.230	88%	
	O (Bot)	-0.0	-0.003		
	σ_1	-1523.1840	-1467.0	103%	*
	σ_2	-1639.7070	-1600.0	102%	
	τ_{max}	58.2615	66.230	88%	

NOTES: Ref: Run ① in Pg 63/64

$$* (\sigma_1 - \sigma_2)_{\text{GENSAP}} = 0.88 (\sigma_1 - \sigma_2)_{\text{STARDYNE}}$$

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COMPARISON OF RESULTS BETWEEN GENSAP VER 3.1

Subject: AND STARDYNE

STRUCTURE TYPE: GRID FRAME (L.CASE #2)

SUPPORT REACTIONS (GLOBAL), LBS. & IN. LBS

NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
9	F _z	0.0	0.0	88%	
	M _x	0.0	0.0		
	M _y	-99.5662	-113.216		
10	F _z	0.0	0.0	88%	
	M _x	0.0	0.0		
	M _y	99.5662	113.216		

NOTES: Ref: runs ① in pg. 63/64

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2.5.2.1

DIFFERENCES IN LOAD APPLICATION METHOD	
ADOPTED BY GENIAP VER 3.1 & STARDYNE	
GENIAP VER. 3.1	STARDYNE
<u>CASE #2</u> (Temperature load in plate) 3. Average temperature change across the cross-section of the cover plate is assumed based on linear variation of the temperature between top and bottom surfaces. ie. Avg. temp change on -Z axis $+2$ $+15^{\circ}\text{F}$ " " " $+2$ " -5°F 4. The forces due to temp. change in the cover plates are assumed to be acting at the outer surface of the cover plates. ie. Lever arm for the moment calculation = $1'$	The surface temperature is assumed uniform across the cross section of the cover plates. ie. Avg. temp change on -Z axis $+15^{\circ}\text{F}$ " " " $+2$ " -5°F The force due to temperature change in the cover plates is assumed to be acting at the centroids of the stress block across the section of the cover plates. ie. Lever arm for Moment calculation = $1.0 - 0.061 = 0.939$
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C. CASE 2: (Plate temperature loads)

Refer to differences 3 & 4 given in page 34/64. Based on these differences in the load realization procedures adopted by GENSAP and STARDYNE, the corresponding results are different by a factor of 0.88. ie Results based on GENSAP ver.3.1 are 0.88 times those based on STARDYNE.

To investigate the above difference the following supporting analysis was performed.

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2.5.2.2 SUPPORTING ANALYSIS # 2:

To investigate the manner in which the temperature loading is applied by GEN/SAP ver. 3.1 and STARDYNE, another supporting analysis was performed.

For Case 2, hand calculations were performed to derive the internally applied nodal forces. These nodal forces were same as those internally generated by the STARDYNE program. This led to the understanding that the factor of 0.88 is due to the difference in the internally applied loads.

The manual derivation of the equivalent nodal forces based on STARDYNE approach and corresponding derivation of the factor 0.88 in comparison with GEN/SAP approach

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are given in the following pages 38 to 44/64

These justify the differences
3 & 4 given in the comparison
table in page 24/64.

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Manual derivation of equivalent-
Nodal loads due to temperature
loading on the honeycomb plates.
(STAROVNE-Approach)

For a flat plate of uniform thickness and of any shape having one face at a temp of T and the other at $T + \Delta T$, the temp gradient between the faces being linear, and having the edges fixed, the maximum resulting bending stress at the edges is given as $= \frac{1}{2} \Delta T \alpha E / (1 - \nu)$

where, α = Coeff. of Thermal Expansion
 E = Modulus of Elasticity
 ν = Poisson's ratio.

(Reference: #5, Page 583.)

In this problem +z surface of Honey-comb plate experiences a temperature difference of -5°F and the -z surface experiences a temperature difference of $+15^{\circ}\text{F}$.

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At positive z surface, bending stress

$$\sigma_{+z} = \frac{1}{2} \times 5 \times \frac{0.000013 \times 10400000}{0.70} = \underline{\underline{482.857 \text{ psi}}}$$

At negative z surface, bending stress

$$\sigma_{-z} = \frac{1}{2} \times 15 \times \frac{0.000013 \times 10400000}{0.70} = \underline{\underline{1448.571 \text{ psi}}}$$

Both these stresses are caused by the forces that act together in creating bending moments about x & y axes.

Bending Moment about x -axis: (due to one rect. panel)

$$(\sigma_{+z} + \sigma_{-z}) \times \text{Area of section of plate} \times \text{lever arm}$$

$$= (482.857 + 1448.571)(30" \times 0.063") (1") = \underline{\underline{3650.39 \text{ in lbs}}}$$

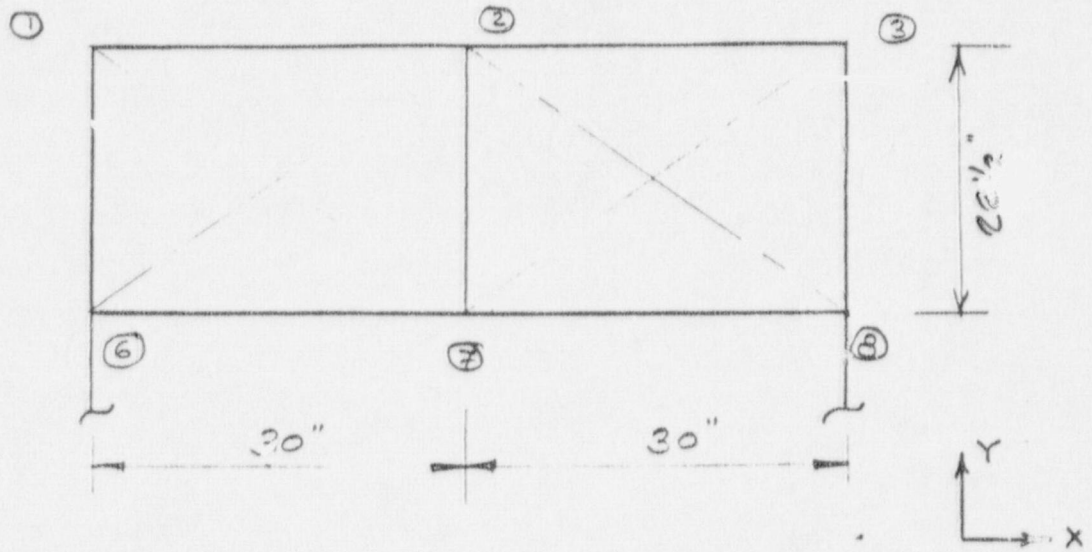
This Moment is shared by the nodes constituting the edge of the plate panel.

Corresponding Moments at Nodes 1, 2, 3, 6, 7 & 8

are,	Node	M_x in#	
	1	$3650.39/2 = 1825.20$	$\rightarrow$
	2	$2 \times [3650.39/2] = 3650.40$	$\rightarrow$
	3	$= 1825.20$	$\rightarrow$
	6	$= -1825.20$	$\leftarrow$
	7	$= -3650.40$	$\leftarrow$
	8	$= -1825.40$	$\leftarrow$

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Bending Moment about Y axis:

$$(\sigma_{+z} + \sigma_{-z}) \times \text{Area of section of plate} \times \text{lever arm} \\ = (482.857 + 1448.571) (22.5 \times 0.063) (1") = 2737.79$$

Distributing this load to appropriate nodes:

Node	$\frac{M_y}{2}$	
1	$\frac{2737.79}{2} = 1368.90$	↑
2	= 0.0	
3	= -1368.90	↓
6	= 1368.90	↑
7	= 0.0	
8	= -1368.90	↓

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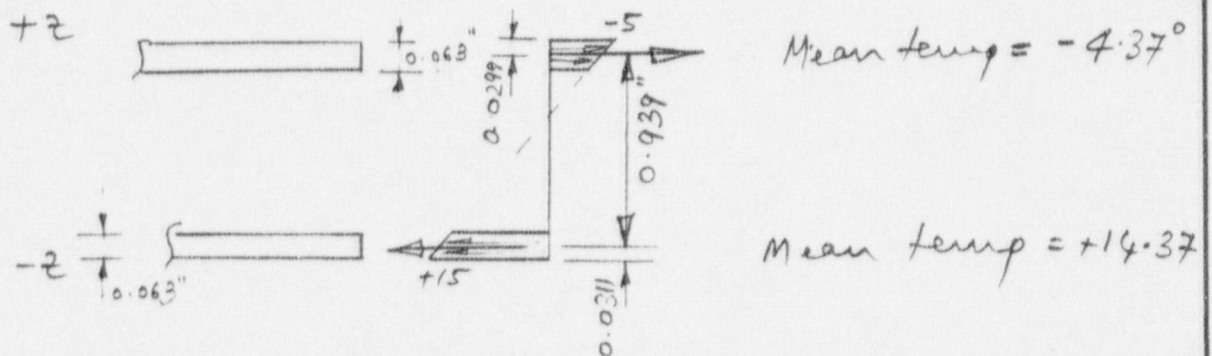
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The above derived equivalent
nodal forces match with those internally
generated by STARDYNE.

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Manual derivation of equivalent
Node forces due to temperature
loading on the honey-comb plates:
(GENIAP approach)



Mean temp across the top & bottom plate cross sections are -4.37°F and $+14.37^{\circ}\text{F}$. Corresponding plate forces act at a distance of 0.939 apart as depicted above.

$\therefore$ The internally calculated moments based on GENIAP will bear a factor with those calculated using STARDYNE. This factor is

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$$\left[\frac{14.37 + 4.37}{15.0 + 5.0} \right] \times \left[\frac{0.939}{1.00} \right] = 0.879$$

$$= \underline{\underline{0.88}}$$

This means that the internally applied loads in the GENSAP program are 0.88 times those based on STARDYNE. Same factor can be realized if one compares the results for thermal load (con. 2) based on GENSAP & STARDYNE (eq 28 to 33/64) the analysis being elastic analysis.

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The above derivations of the internally applied nodal forces based on STARDYNE and GENSAP programs show the reason as to why there is a factor of 0.83 involved in the GENSAP results as compared to STARDYNE results.

However, since GENSAP approach is more logical and appropriate, the GENSAP results could be used without any reservations for honeycomb panels consisting of thin cover plates.

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2.6.0 ADDITIONAL ANALYSIS

(GRID FRAME USING
HOMOGENEOUS PLATE 0.125" THK
INSTEAD OF HONEY-COMB RT.)

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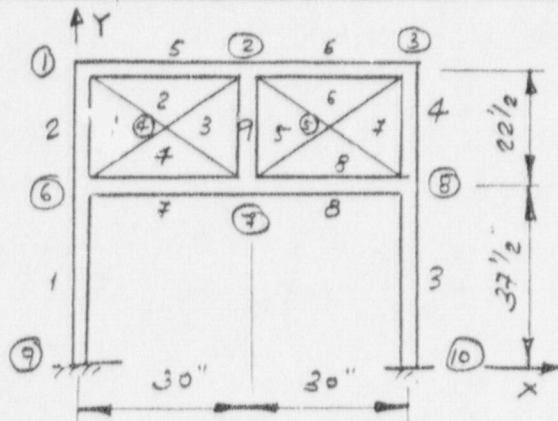
The honeycomb panels in the model were replaced with 0.125" THK. homogeneous plates and the analysis was performed using GENSAP ver. 3.1 and STARDYNE. C. Case 1 was applied as equiv. nodal forces and C. Case 2 was applied as temperature load in the GENSAP run. The results matched 100% with those based on STARDYNE as can be seen from the comparison tables on pages ($\frac{48}{64}$ thru 59/64).

The nodal force calculations and the results comparison between GENSAP & STARDYNE are given in the following pages.

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Calculation of equivalent nodal forces for Case 1. (pressure & G-loads)



Total wind pr. load based on 1440°
 $= 22.5 \times 60 \times 0.15 = 202.5$

G-load due to plate based on
 $1440^\circ = 0.125 \times 60 \times 22.5 \times 0.100$
 $= 16.875 \#$

G-load due to members 1 & 3
 $= 37.5 \times 0.929124 \times 0.100 = 3.484 \#$

G-load due to members 5, 6, 7 & 8
 $= 30.0 \times 0.929124 \times 0.100 = 2.787 \#$

G-load due to members 2, 9 & 4
 $= 22.5 \times 0.929124 \times 0.100 = 2.091 \#$

Node #	Wind pressure load on plates (0.15#/in --Z Dir)	G-load on the whole structure (+Z Dir)		Total nodal load (#)
		plate	member	
1	-12.656 #	1.054	2.439	-9.163
2	-25.313	2.109	3.833	-19.370
3	-12.656	1.055	2.439	-9.163
4	-50.625	4.218	-	-46.406
5	-50.625	4.218	-	-46.406
6	-12.656	1.055	4.181	-7.421
7	-25.313	2.109	3.833	-19.370
8	-12.656	1.055	4.181	-7.421
9	-	-	1.742	1.742
10	-	-	1.742	1.742

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1

Subject: AND STARDYNE

STRUCTURE TYPE: GRID FRAME

CASE 1

NODAL DISPLACEMENTS (GLOBAL)

NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	δ_z	-0.109596	-0.1095958	100%	
	Q_x	-0.0025866	-0.0025865		
	Q_y	0.0003018	0.0003018		
7	δ_z	-0.0580366	-0.0580365		
	δ_x	-0.0025273	-0.00252729		
	δ_y	0.0	0.0		

NOTES:

- WITH SOLID PLATE 0.125" THK

Ref: Run (3) in Pg 64/64

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COMPARISON OF RESULTS BETWEEN GENSAP Ver. 3.1
Subject: AND STARDYNE

STRUCTURE TYPE: GRID FRAME CASE 1

ELEMENT FORCES & MOMENTS (LBS & IN. LBS.) LOCAL COORD.

ELEM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	9	F _z	82.360	82.360	100%	
		M _x	-38.0607	-38.061		
		M _y	-4034.6475	-4034.641		
5	2	F _z	-5.0375	-5.038		↓
		M _x	17.9226	17.923		
		M _y	-472.5002	472.506		

NOTES:

- WITH SOLID PLATE 0.125" THK

Ref: Run (3) in
Pg 64/64

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME, C. CASE. 1

MEMBER STRESSES (PSI)

ELEM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	9	σ_y	-3189.4447	-3190.3	100%	
4	8	σ_y	-422.6326	-422.74		
8	7	σ_y	336.2943	336.39		

NOTES:

WITH SOLID PLATE 0.125" THK

Ref: Specs ③ in
Pg 64/64

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Prepared By/Date	AM 11/20/82					
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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME

C. CASE 1

PLATE CORNER FORCES (LBS.)

ELEM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	1	Fz	-22.7761	-22.776	100% ↓	
		Mx	3.7721	3.772		
		My	258.9878	258.987		
	6	Fz	31.1402	31.140		
		Mx	58.9071	58.907		
		My	306.2633	306.263		
	4	Fz	-8.3641	-8.364		
		Mx	62.7830	62.783		
		My	41.3075	41.307		

NOTES:

WITH SOLID PLATES
0.125" THICKRef: Run (3) in
Pg. 64/64

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1 AND STARDYNE

Subject: _____

STRUCTURE TYPE: GRID FRAME (CASE 1)

PLATE STRESSES (psi)

Ref #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	θ (top)	-5.57	-5.574	100 % ↓ V	
	σ_1	5.8887	5.889		
	σ_2	-1.8442	-1.844		
	τ_{max}	3.8665	3.866		
	θ (bot)	84.43	84.426		
	σ_1	1.8442	1.844		
	σ_2	-5.8887	-5.889		
	τ_{max}	3.8665	3.866		

NOTES:

WITH SOLID PLATE 0.125" THK
Ref: Run in Page 64/64

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COMPARISON OF RESULTS BETWEEN GENSAP VER 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME

(CASE 1

SUPPORT REACTIONS (GLOBAL), LBS. & IN. LBS

NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
9	F _z	82.360	80.618 *	~100%	
	M _x	4034.6475	4034.641		
	M _y	-38.0607	-38.061		
10	F _z	82.360	80.618 *		
	M _x	4034.6475	4034.641		
	M _y	38.0607	38.061		

NOTES:

WITH SOLID PLATES 0.125" THK

Ref: Run ③
in 64/64

* Refer pages (61, 62/64) for description

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME L.CASE: 2

NODAL DISPLACEMENTS (GLOBAL)

NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	δ_z	0.0005038	0.000503825	100% ↓	
	δ_x	0.0000448	0.00004476		
	δ_y	0.0000423	0.00004227		
7	δ_z	-0.0005957	-0.0005957		
	δ_x	-0.0000205	-0.00002046		
	δ_y	0.00	0.0		

NOTES:

WITH SOLID PLATES 0.125" THK

Ref. Run (3) in
Pg. 64/64

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Checked By/Date	W. H. H. / 82					

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COMPARISON OF RESULTS BETWEEN GENSAP Ver. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME L. CASE: 2

ELEMENT FORCES & MOMENTS (LBS & IN. LBS.) LOCAL COORD.

ELEM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	9	F_x	0.0	-0.0	100%	
		M_y	-5.2678	-5.268		
		M_z	-0.0	0.0		
5	2	F_x	0.0050	0.005		
		M_y	2.8406	2.841		
		M_z	-55.5209	-55.521		

NOTES:

WITH SOLID PLATES 0.125" THK

Ref: Run (3) in

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Prepared By/Date AM 11/20/82

Checked By/Date RV 11/24/82

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1

Subject: AND STARDYNE

STRUCTURE TYPE: GRID FRAME

CASE: 2

MEMBER STRESSES (PSI)

ELSM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	9	σ_y	- 0.0	- 0.0	100 %	
4	8	σ_y	62.1406	62.157		
8	7	σ_y	41.3263	41.337		

NOTES:

WITH SOLID PLATES 0.125" THK

Ref: Run (3) in
8/64/64

Revision	0					
Prepared By/Date	AM 11/20/82					
Checked By/Date	RV 11/24/82					

56/64

COMPARISON OF RESULTS BETWEEN GENSAP Ver. 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAMEC. CASE: 2

PLATE CORNER FORCES (LBS.)

ELSM #	NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	1	F _z	0.0164	0.016	100%	
		M _x	28.2748	28.275		
		M _y	-37.8758	-37.876		
	6	F _z	-0.0151	-0.015		
		M _x	28.2886	28.289		
		M _y	37.5150	37.515		
	4	F _z	-0.0013	-0.001		
		M _x	-56.5437	-56.544		
		M _y	0.0071	0.007		

NOTES:

(WITH SOLID PLATE 0.125" THICK

Ref: Run (3) in
Pg 54/64

Revision	0					
Prepared By/Date	AM 11/20/82					
Checked By/Date	PV 11/24/84					

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COMPARISON OF RESULTS BETWEEN GENSAP VER. 3.1 AND STARDYNE

Subject: _____

STRUCTURE TYPE: GRID FRAME (CASE 2)

PLATE STRESSES (psi)

Pl #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
1	O (top)	-84.13	-84.131	100%	↓
	σ_1	1930.3678	1930.00		
	σ_2	1929.8096	1930.0		
	τ_{max}	0.2791	0.2791		
	O (bot)	5.87	5.869		
	σ_1	-1929.8096	-1930.0		
	σ_2	-1930.3678	-1930.0		
	τ_{max}	0.2791	0.2791		

NOTES:

WITH SOLID PLATE 0.125" THK

Ref: Run ③ in
Pg 64/64

Revision	0					
Prepared By/Date	AM 11/20/82					
Checked By/Date	SV 11/24/82					

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COMPARISON OF RESULTS BETWEEN GENSAP VER 3.1

Subject: AND STARDYNESTRUCTURE TYPE: GRID FRAME (CASE: 2)

SUPPORT REACTIONS (GLOBAL), LBS. & IN. LBS

NODE #	TYPE	GENSAP VER. 3.1	STARDYNE	PERCENTAGE COMPARISON	REMARKS
9	F _z	0.0	0.0	100% ↓	
	M _x	0.0	0.0		
	M _y	-5.2678	-5.268		
10	F _z	0.0	0.0		
	M _x	0.0	0.0		
	M _y	5.2678	5.268		

NOTES:

WITH SOLID PLATE 0.125" THK

Ref: Run (3) in
Pg 64/64

Revision	0					
Prepared By/Date	AM 11/20/82					
Checked By/Date	RV 11/24/82					

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Project

GENSAP VERIFICATION

File No.

Owner

NUTECH

Client

This analysis validates the use of GENSAP ver. 3.1 for the Grid Frame problems consisting of Homogeneous plate panels.

Also this analysis reinforces the load application differences 1 and 2 tabulated in page 14/64 for C. Case 1 and confirms that the load application differences 3 & 4 for C. Case 2 as given in page 34/64 are due to the presence of honey-comb panels.

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Prepared By/Date	AM 11/20/82					of	64
Checked By/Date	RV 11/24/82						

Project GENAP VERIFICATION File No. _____
 Owner NUTECH
 Client _____

2.7.0 REASONING FOR THE DIFFERENCE
IN SUPPORT REACTION "F₂" BETWEEN
THE RUNS MADE WITH ACTUAL L.CASE 1
AND THE RUNS MADE WITH EQUIVALENT
NODAL FORCES FOR L.CASE 1

Refer Pages: (25/64 & 53/64).

When equivalent nodal forces are applied as physical external nodal forces instead of the actual forces, there exists a nodal force at the support location also. Since this nodal force takes part in the nodal equilibrium of that support Node, the reactions printed out in the runs with actual loads and with equivalent nodal loads differ by an amount equal to that particular nodal force. (Refer Pages 19/64 & 47/64)
 But when the actual

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Checked By/Date	LV 11/24/82						

Project GENSAP VERIFICATION File No. _____
Owner NUTECH _____
Client _____

load is applied on the model instead of the equivalent nodal forces the programs internally take into account the nodal forces thereby printing the actual support reactions, as can be seen in page (13/64).

Since equivalent nodal forces were applied to the model only as a means of investigation, the above discrepancy is justified. In practice the actual loads will be applied and the reactions obtained in that fashion will be correct as seen above from page 13/64.

—

Revision	0					Page	17
Prepared By/Date	AM 11/20/82					of	104
Checked By/Date	LV 11/24/82						

Project STENS HP VERIFICATION File No. _____
 Owner NUTECH
 Client _____

2.8.0 COMPUTER RUN ID'S & TAPE/FILE DETAILS

VERIFICATION OF GENAP VER.3.1 AGAINST STARDYNE

2.8.0 COMPUTER RUN ID'S & TAPE / FILE DETAILS						
VERIFICATION OF GEN SAP VER.3.1 AGAINST STARDYNE						
EXAMPLE PROBLEM	GEN SAP 3.1 / STARDYNE	COMPUTER RUN ID / DATE	OUTPUT FILE NAME	DETAILS OF TAPES SAVED	FILE / ARCHIVE DETAILS	REMARKS
① GRID FRAME (HONEY-COMB PANELS)	GEN SAP STARDYNE	10-22-82 MCTVAGL 10/26/82	DEMAM4 -	- L= GRID T2,4,T,9 I= GEN SAP VER, D=PE, BF, VSN= P17638 L= GRID T2,4,T,9 OUT I= GEN SAP VER, D=PE, BF VSN= P22207	-	
② GRID FRAME (WITH EQUIV. NODE FORCES FOR LOADE1)	GEN SAP	10-28-82	EX4M30	-	-	

Project GENSAP VERIFICATION File No. _____
 Owner NUTECH
 Client _____

COMPUTER RUN ID'S & TAPE/FILE DETAILS

VERIFICATION OF GENSAP VER.3.1 AGAINST STARDYNE

EXAMPLE PROBLEM	GENSAP 3.1 STARDYNE	COMPUTER RUN ID/ DATE	OUTPUT FILE NAME	DETAILS OF TAPES SAVED	FICHE/ARCHIVE DETAILS	REMARKS
-	-	-	-	-	-	-
③ GRID FRAME (WITH 0.125" THK SOLID PLATES)	GENSAP STARDYNE	10-26-82 MFPXAK3 10-26-82	EX4M2Φ -	- L= GRID T2,4,7,9 I= GENSAPVER ; D=PE ; B F VSN= P23246 L= GRID T2,4,7,9 OUT I= GENSAPVER ; D=PE, BF VSN= PA2734	- - -	-

Revision

0

Prepared By/Date

AM 11/20/82

Checked By/Date

RV 11/24/82

Page

of

64
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ENCLOSURE 4

BASEPLATE II VERIFICATION REPORT



RECEIVED

JUN 18 1982

W. E. BOOTH

June 17, 1982

Mr. Wayne Booth
Corporate QA Manager
Nutech, Inc.
6836 Via Del Oro
San Jose, CA 95119

Dear Mr. Booth:

It is the policy of COMSOURCE/CYBERNET to maintain a list of CYBERNET applications which are determined to be safety-related. The list of safety-related applications will be used in conjunction with the policies and procedures documented in the COMSOURCE/CYBERNET Quality Assurance Policies & Procedures Revision E dated April 1, 1982.

The list of safety-related applications which are currently subject to Revision E of the COMSOURCE/CYBERNET Quality Assurance Policies and Procedures (specifically, Policy QA 02.05.00) are:

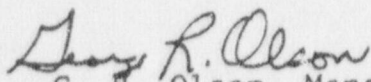
<u>File</u>	<u>Name</u>	<u>Revision level as of 6/16/82</u>
08.025	ADLPIPE (Not used at NUTECH)	1D
08.017	ANSYS	REV3 67L1 and REV4 40C
08.113	BASEPLATE II	1.0
	CASMO	1.00
	DIS	1.D
08.044	EASE (aka EASE2, EASEII)	13.3
	FLUSH (aka CDC-FLUSH)	2.4
	GTSTRUDL	81.05
08.019	MARC (aka MARC/CDC)	J.2
08.134	NASTRAN (aka MSC/NASTRAN, CDC/NASTRAN)	on NOS 61B on SCOPE 61
	NUPIPE (aka NUPIPE II, NUPIPE II SYSTEM)	1.5.1

<u>File</u>	<u>Name</u>	<u>Revision level as of 6/16/82</u>
	PDQ7	4
	PDQ8	1.02
	PIPERUP	V.1.3
08.026	PIPESD (Not used at NUTECH)	6.1A
	PLOT-10	3.3 RELO2
	RELAP4	MOD4 = 1.0
08.149	RELAP5	MOD1 = 2.11
	REPIPE	1.3
08.012	STARDYNE	APRO282
	SUPERNODE	B=1.0 P=1.0
	UNIPL0T	3.1R04
	UNISTRUC	14APR82

Except for the revision level, all of the above information is contained in COMSOURCE/CYBERNET Quality Assurance Policies and Procedures Revision E dated April 1, 1982.

Sincerely,

CONTROL DATA CORPORATION


G. R. Olson, Manager
COMSOURCE Quality Assurance

C: S. L. Westin SVEDSØ

/kc



145 MARTINVALE LANE • SAN JOSE, CALIFORNIA 95119 • PHONE (408) 629-9800 • TELEX 352062

June 17, 1985
RHS-85-077

Mr. Blaine H. Patrick, Manager
CYBERNET Quality Assurance
8100 34th Avenue South
P. O. Box 0
Minneapolis, MN 55440

Subject: Quality Assurance Audit Report

Dear Mr. Patrick:

A quality assurance audit of Control Data Corporation (CDC) was conducted on June 13, 1985. The scope of the audit was to verify implementation of your QA program to support the supply of safety-related computer software services to NUTECH for 10CFR50, Appendix B, applications. The results of that audit are described in the attached audit report. There were no findings noted and the subject audit is considered closed. No additional response from CDC is required.

Please accept my thanks for the cooperation extended to Mr. Booth during the audit.

If you have any questions or comments concerning this audit report, feel free to contact me at (408) 281-6119.

Sincerely,

R. H. Booth
Quality Assurance Administrator

RHS/sjm

Enclosures

cc: S. Westin, CDC

bcc: QASJO.0305.CDC8506
W. E. Booth

AUDIT REPORT

AUDIT TYPE: Supplier AUDIT REPORT No: CDC-85-06
AUDIT DATE(s): June 13, 1985 FILE No: QASJO.0305.CDC

AUDIT SCOPE:

The purpose of the audit was to verify, by examination of objective evidence, implementation of the policies and procedures defined by Control Data Corporation's "CYBERNET Application Quality Assurance Policy and Procedure" manual. The scope of the audit included Organization; Design Control; Procurement Document Control; Instructions, Procedures, and Drawings; Document Control; Control of Purchased Services; Corrective Action; Quality Assurance Records; and Audits.

AUDIT SUMMARY

The computer program REPIPE was selected as a sample to verify implementation of the quality assurance program. All attributes examined during the audit were found to be in compliance with the applicable procedure(s). Files and records appeared to be well organized and complete. It was noted that CDC has made significant progress in both definition and implementation of their quality assurance program since the last NUTECH audit in 1982. As a result of this audit and because of a history of satisfactory performance, Control Data Corporation will continue to remain on NUTECH's Approved Suppliers List for providing safety-related computer software services. This audit is considered closed.

AUDIT CONTACTS AND ATTENDANCE:

Blaine H. Patrick, Manager
Mary J. Stevens
Scott Harris

CYBERNET Quality Assurance
Professional Services Division
Mechanical Engineer

AUDIT REPORT CLOSE-OUT:

No close-out actions required.

W.E. Booth
W. E. Booth
Audit Team Leader

6/17/85
Date

R. H. Smith
R. H. Smith
Quality Assurance Administrator

6.17.85
Date

ENCLOSURE 5

STARDYNE VERIFICATION REPORT