TWP Timber and Wood Products Research Centre

STATIC AND DYNAMIC TEST RESULTS FOR 3.6 X 3.6 m PLYWOOD SERVICES LOW PROFILE FLOOR SYSTEM

C.G. McDowall
A.I.W.Sc., M.I.E. Aust.
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AE, ROCKHAMPTON, AUSTRALIA 4700. TELEPHONE (079) 361177 TELEX AA49176

TABLE OF CONTENTS

				Page No.
	SUMMARY			(ii)
1.	INTRODUCTION			1
2.	FLOOR DESCRIPTION AND CONSTRUCTION			2
	2.1	Joists		1
	2.2	Bearers		1
	2.3	Bearer/Sub–Floor Connection		3
	2.4	Sheathing		3
3.	TEST PROCEDURE			3
	3.1	Dial Gauge Location		3
	3.2	Plywood Sheathed Only		5
		3.2.1	Concentrated Loads	5
		3.2.2	Restricted Area Loading	5
		3.2.3	Uniformly Distributed Live Loading	7
		3.2.4	Dynamic Loading	7
	3.3	Plywood/Gyprock Sheathed		10
4.	TEST RESULTS			10
	4.1	Plywood Sheathed Only		11
	4.2	Plywood/Gyprock Sheathed		11
	4.3	Reduced Data		14
5.	CONCLUSIONS			16
	5.1	Recommendations		17
		5.1.1	Ultimate Limit State	18
		5.1.2	Long Term Response	18
		5.1.3	Short Term Serviceability Limit States	18
	5.2	Final Comments		19
6.	REFERENCES			19
	APPENDIX 1			20
	APPENDIX 2			24

SUMMARY

This report describes the construction of, and static and dynamic tests performed on, a 3.6 x 3.6 m "low profile" floor system. The timber framing system comprised 200 x 35 mm x F8 bearers connected planar with 200 mm deep, double plyweb beams as joists. The walking surface of the floor was sheathed with 13 mm thick structural plywood glue/nailed to the bearers and joists. The two adjacent edge joists were at 360 mm centres with the internal joists at 480 mm centres. The underside of the floor was lined with 10 mm gyprock connected "in–situ" after the "plywood sheathed only" construction had been subjected to a full range of tests. The new construction was then subjected to the identical set of static and dynamic tests. A further dynamic test involving determination of the resonant frequency with the floor subjected to 1/3 of the live load was also performed.

1. INTRODUCTION

Plywood Services supplied TWP with double plywood web joists, solid Oregon pine bearers (see Plate 1) and 13 mm thick x 2400 x 1200 structural plywood sheathing to construct a low profile floor system having dimensions 3.6 x 3.6 m.

Although the Capricornia Institute 3–Dimensional Loading Frame is only 3.3 m wide, the 3.6 x 3.6 m floor, mounted on its own steel sub–floor frame was fitted into the space between four columns by arranging it such that a floor diagonal was oriented along the longitudinal axis of the Frame as shown in Plate 5. Locating the floor in this manner allowed the longitudinal RSJ (see Plate 5) to be positioned such that a jack concentrated load could be applied to any desired point on the floor surface. Also, moving the reaction beam to one side of the loading frame, allowed concrete blocks to be applied simulating uniformly distributed loading (udl) as shown in Plates 6 and 7.

After testing the floor system for both static and dynamic response the underside was sheathed with 10 mm thick gyprock and the system subjected to the same test procedure as described in Section 3.

2. FLOOR DESCRIPTION AND CONSTRUCTION

Floor construction varied from the norm in that the solid Oregon pine bearer and the double plyweb joists were confined to the same plane. Hence, the plywood sheathing when glue/nailed to the floor was directly connected to the bearer, which does not happen in normal bearer/joist floor construction. Such a system has become known as a "low profile" construction.

2.1 Joists

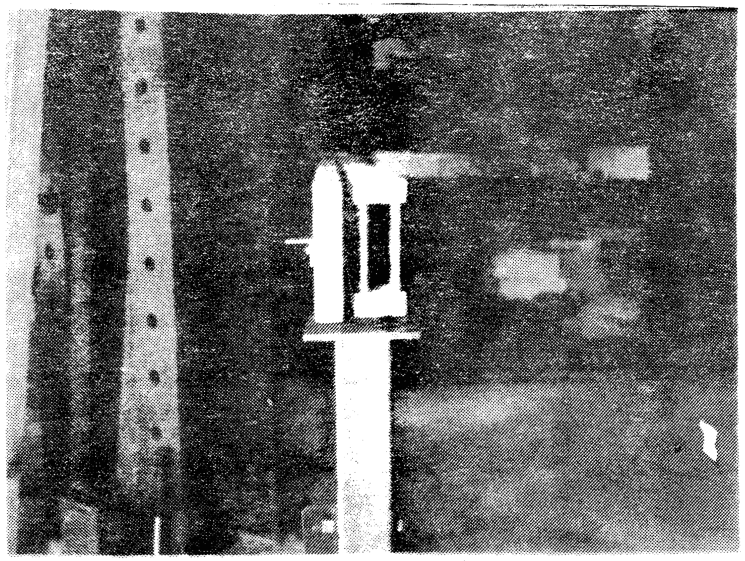
The joists consisted of 70 x 35 mm x F5 pine flanges slotted in two positions to accommodate 7 mm thick plywood webs, 35 mm apart, as shown in Plate 1. The overall depth of the joist was 200 mm with one end blocked for manufacturing purposes (see Plate 2) and the other end left open. In construction of the floor, blocked and unblocked ends were alternately positioned adjacent to each other at the same end of the floor.

Interconnection to the solid bearer was effected through a glue (Maxbond)/nailed connection.

The two edge joists on both sides of the floor were spaced at 360 mm centres and the internal joists at 480 mm centres.

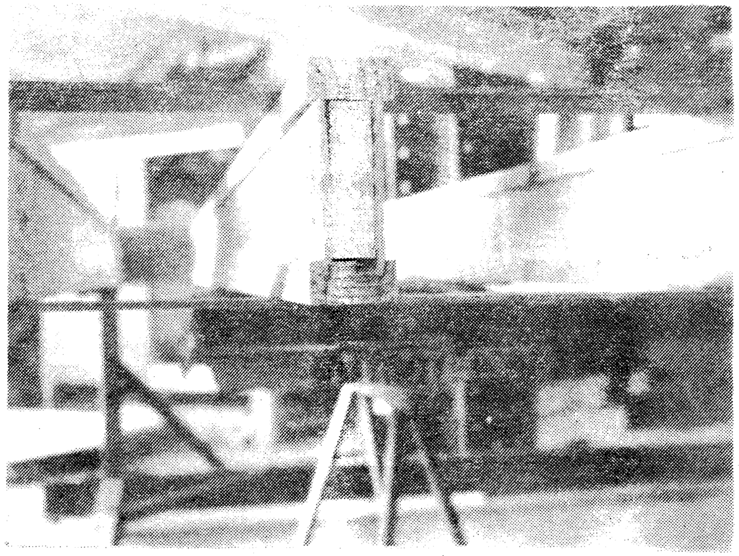
2.2 Bearers

The solid Oregon bearers were 200 x 35 mm x F8, that is, they were the same depth as the joists. At positions where joists framed in, the bearers and joist flanges were predrilled, to accommodate 4 – 3.15 mm diameter x 75 mm long nails. The reason for predrilling was to ensure the joists were not split during nailing. Although a significant proportion of the shear would be transferred through the plywood it was still considered desirable to ensure no splitting occurred during construction.



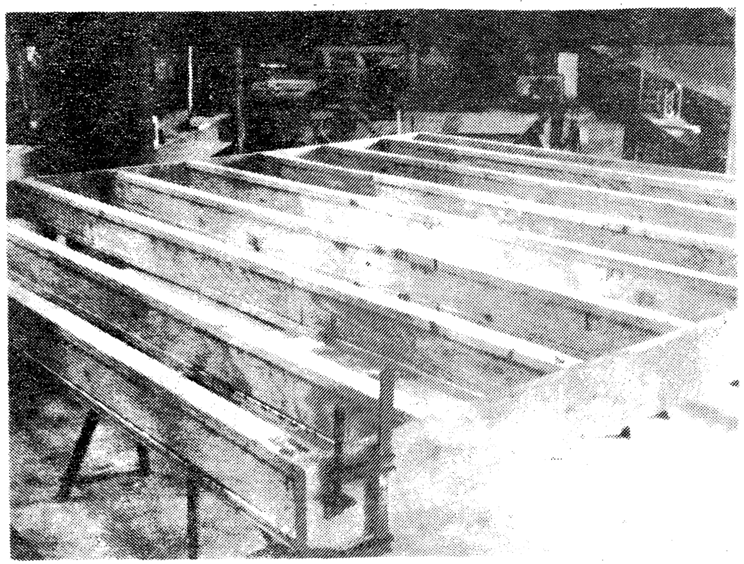
Shows Cross Section of Bearer
and Open End of Joist

Plate 1



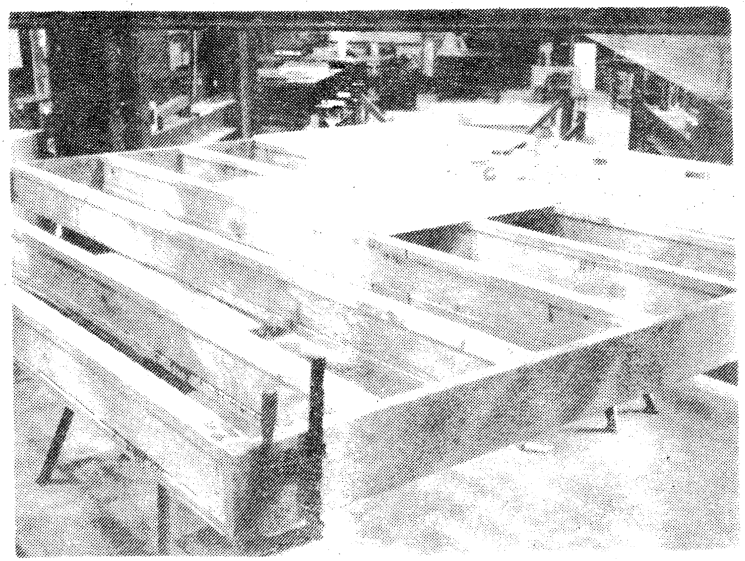
Shows Cross Section of Blocked end of Joist

Plate 2



Joists and Bearers Interconnected
Prior to Sheathing

Plate 3



Partial Sheathing showing Plywood Lay-Up

Plate 4

2.3 Bearer/Sub–Floor Connection

Bearers were connected to the flange plate of each steel stump by means of a piec of angle bolted to the bearer end at mid–height as shown in Plate 1. A clamp wa then applied to the angle and stump plate cap as shown in Plate 3. This method c connection is considered to be absolutely minimal and thus provides a "lowe bound" on floor boundary support.

2.4 Sheathing

The walking surface of the floor system was sheathed with 2400 x 1200 x 13 mr thick structural plywood. Connection between the plywood and the top faces of th bearers and joists was effected by glue/nailing. The glue used was Maxbon elastomeric adhesive manufactured by H.B. Fullers. The necessary clamping force to ensure satisfactory glue bond was provided by nailing the plywood to the timbe framing using 2.8 mm diameter x 40 mm long hand driven galvanised clouts. Th glue was allowed a week–end to cure before any load was applied to the floor. Th plywood sheathing lay–up is shown in Plate 4.

After the static and dynamic serviceability testing program was completed th underside of the floor system was sheathed with 10 mm thick x 3600 x 1500 mn gyprock sheets. The floor system was left in the test rig and the sheathing fittec simulating on–site construction techniques. The possibility of removing the floo from the test rig to apply the ceiling sheathing was considered, but quickl abandoned because of its deviation from site practice.

The gyprock interconnection to the underside surfaces of the bearers and joists using proprietary adhesive, closely followed the instructions listed on the container.

3. TEST PROCEDURE

The test procedure discussed herein describes the positioning of dial gauges and the load cases to which the floor system was subjected when:

1. sheathed one side only with 13 mm thick structural plywood;

2. as in (1), but also sheathed on the underside with 10 mm thick gyprock.

3.1 Dial Gauge Locations

Figure 1 shows the positions at which it was considered desirable to measure floor deflections. However, because of a shortage of dial gauges measurements could only be taken at nodes 4, 5, 6; 10, 11, 12; 16, 17, 18; 22 and 23.

Although the number of gauges had to be reduced to less than half the desired number, through lack of availability, the main positions on the floor were still monitored for deflections. This dial gauging procedure provided sufficient data to establish a floor "deflection profile".

3·6 x 3·6 m PLYWOOD SERVICES LOW PROFILE FLOOR

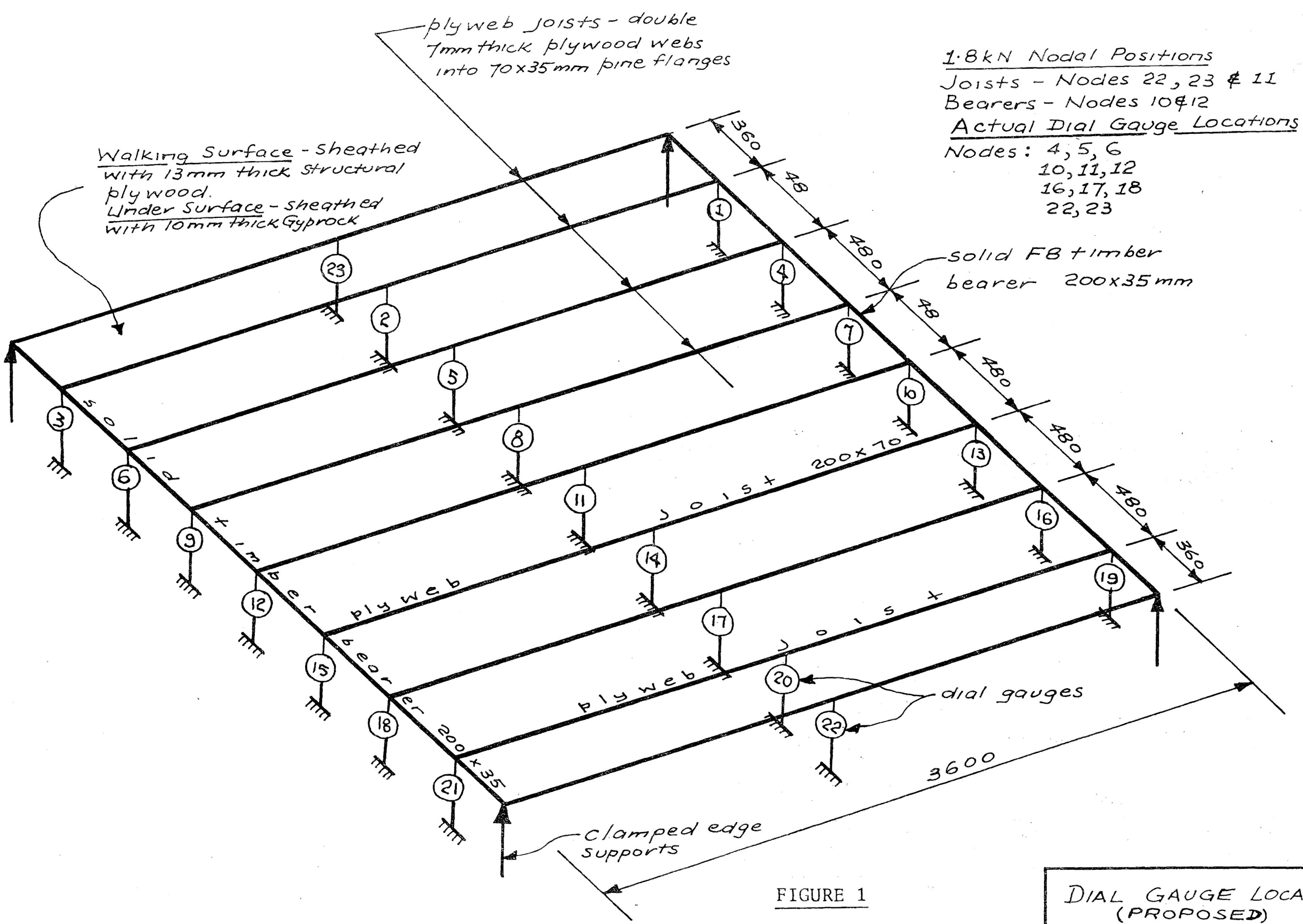


FIGURE 1

DIAL GAUGE LOCATIONS
(PROPOSED)

3.2 Plywood Sheathed Only

The purpose of the test procedure followed, was to as realistically as possible, assess the **serviceability response characteristics** of the floor system with respect to:

(a) **static loading** simulating practical live load (1) conditions represented as:

- 1.8 kN concentrated load applied at selected sensitive locations on the floor;
- 3 kPa uniformly distributed "restricted area" loading applied to the centre joist;
- 1.5 kPa uniformly distributed load over the whole floor.

(b) **dynamic loading** applied in the form of a "mechanical shaker"to determine the **resonant frequency** of the system. for the "shaker" positioned at mid–span of:

- the floor system
- a floor joist

3.2.1 Concentrated Loads

The 1.8 kN load was applied by means of a computer controlled jack, slung from the bottom flange of an RSJ, such that it could traverse the full length of the Loading Frame as shown in Plate 5. The RSJ could also be moved laterally across the Loading Frame providing access to any desired loading point on the floor surface.

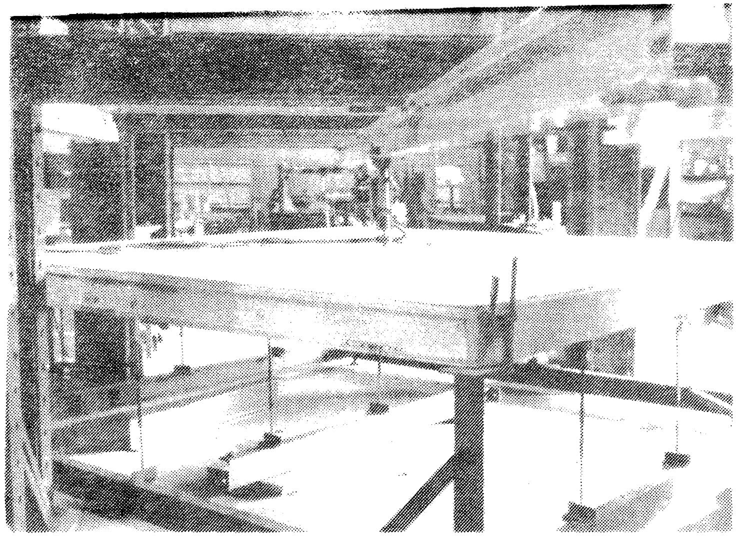
For this series of tests the loaded nodes were identified by the same numbers used to identify the dial gauge positions as shown in Figure 1. That is, the 1.8 kN load was applied at nodes:

- 10 and 12 at mid–span of the two end bearers
- 22 and 23 at mid–span of the two edge joists
- 11 at mid–span of the floor system.

3.2.2 Restricted Area Loading

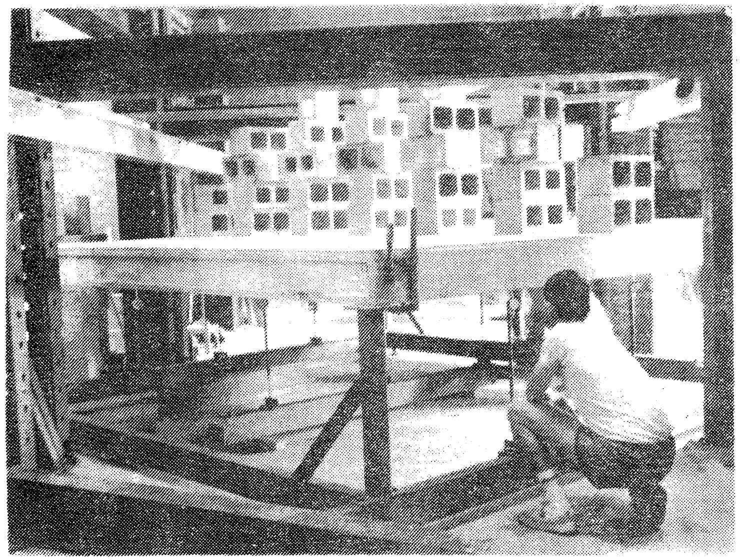
The restricted area loading (1) was estimated to be approximately 3 kPa applied to the centre joist. To simulate this loading, concrete blocks were placed at nodes identified 27 to 33 inclusive, shown in Figure 2. The number of blocks per node were:

- 2 blocks/node at nodes 27 and 33
- 5 blocks/node at nodes 28 and 32
- 6 blocks/node at nodes 29, 30 and 31.



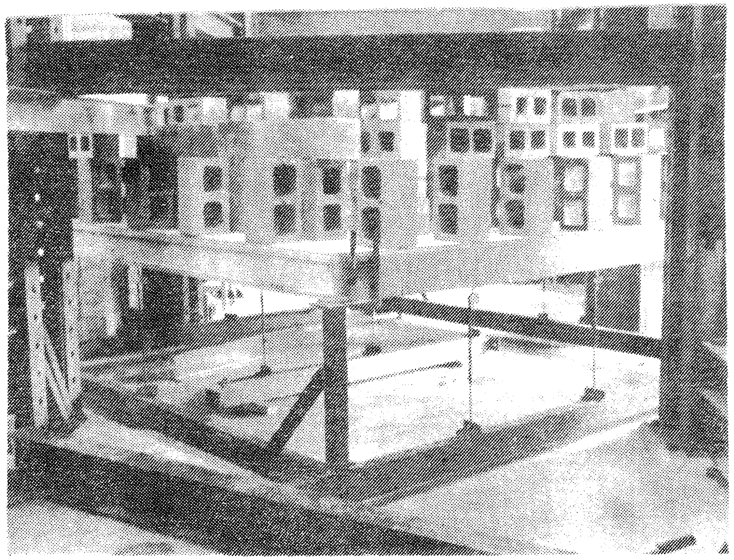
Shows 1.8 kN Concentrated Load
Applied at Mid Span

Plate 5



Restricted Area U.D. Loading Applied
to Centre Joist

Plate 6



1.5 kPa U.D. Live Load Applied to the
Floor

Plate 7

Loading of the nodes was done in three stages with two blocks being applied to each of the seven nodes in the first stage. Dial gauge readings were then taken. At the second loading three further blocks were applied to each of nodes 28, 29, 30, 31 and 32. Dial gauges were again monitored. In the final loading increment a single block was applied to each of nodes 29, 30 and 31. Dial gauges were read and the load left for five minutes. Dial gauge readings were again taken and all of the concrete blocks removed and residual deflections monitored.

Plate 6 shows the configuration of concrete block simulating the restricted area live load.

3.2.3 Uniformly Distributed Live Loading

The 1.5 kPa uniformly distributed live load (1) was simulated by the application of concrete blocks to the 59 nodes of Figure 2. The number of blocks per node were:

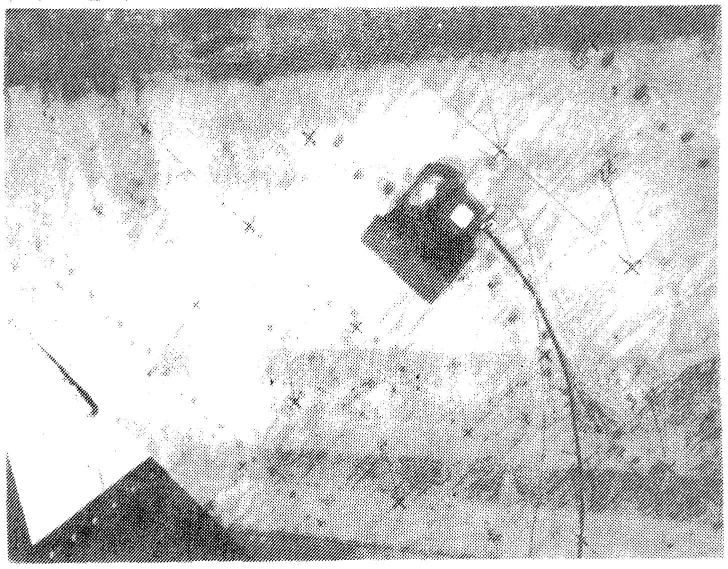
- a single block to each edge node;
- two blocks to each of the nodes 7 through 11, 49 through 53, and nodes 14 and 18, and 42 and 46;
- three blocks to all other internal nodes.

Loading of the floor system was done in three stages with a single block being applied to each node and deflections monitored during the first stage. At the second loading a further block was added to each of the internal nodes and the deflection readings taken. During the final loading stage a third block was added to the nodes shown in Figure 2. Dial gauges were read and the load left for 5 minutes. Dial gauge readings were again taken and the load removed as quickly as possible, and residual floor deflections monitored.

Plate 7 shows the distribution of the concrete blocks over the floor system simulating the 1.5 kPa live loading.

3.2.4 Dynamic Loading

The floor system was subjected to dynamic loading by means of the "mechanical shaker" shown in Plate 8.



"Mechanical Shaker" located at mid–span of Floor

Plate 8

The basic construction of the shaker involves a small, variable speed control, electric motor which generates a vertical cyclic force in a plane perpendicular to the surface of the floor being excited. The device can easily be bolted to the floor and is capable of exciting it up to, and through, the resonant frequency, even when the floor is subjected to substantial loading.

Resonant frequency of the floor under **no load** conditions, was determined for the shaker located at the following nodes defined for positioning dial gauges:

- mid–span of the floor, i.e. node 11. The amplitude of vibration was also determined for node 11;
- node 5 and amplitude for node 11;
- quarter point of joist $\overline{10,12}$ and amplitude for node 11.

3·6 x 3·6 m PLYWOOD SERVICES LOW PROFILE FLOOR

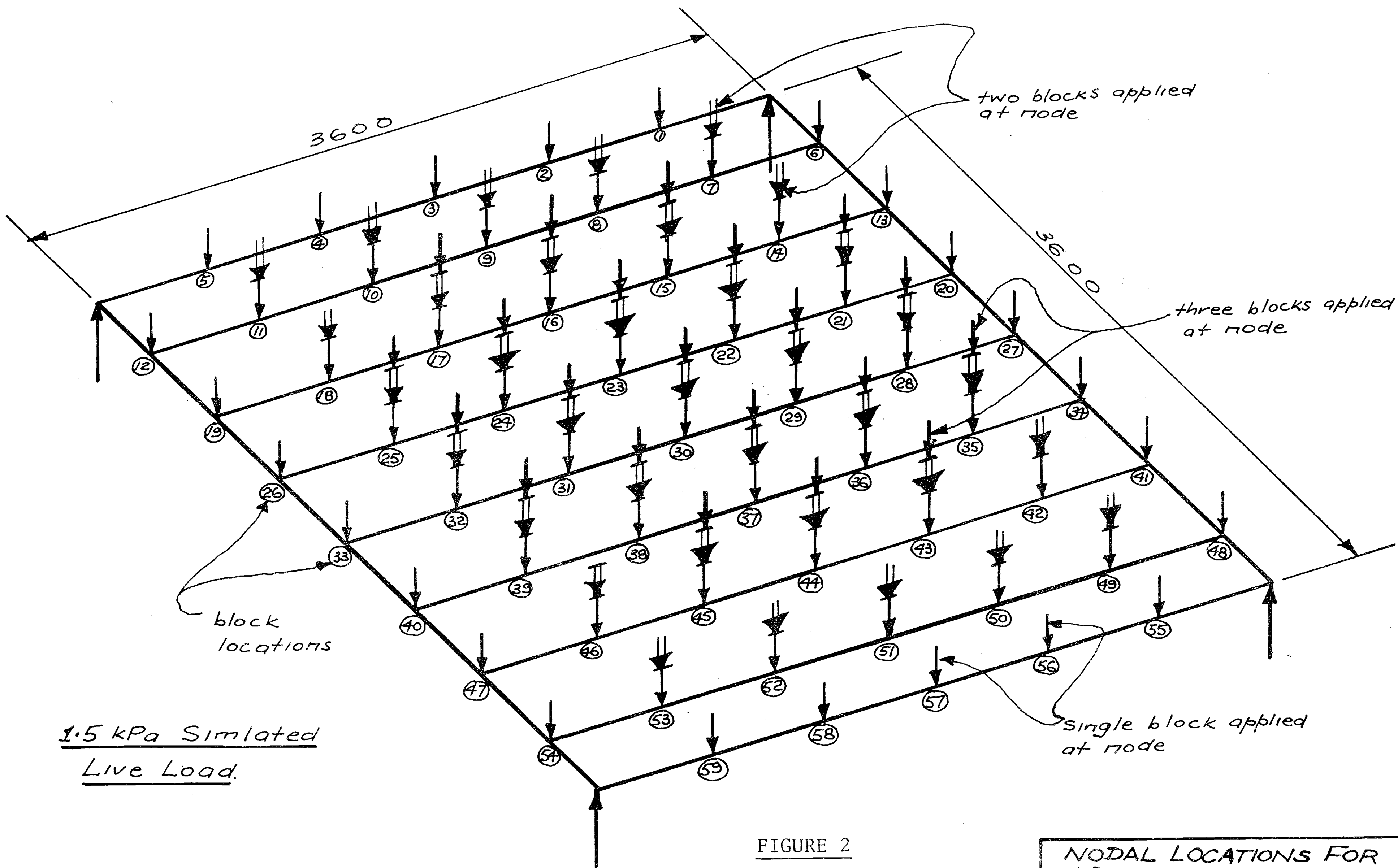
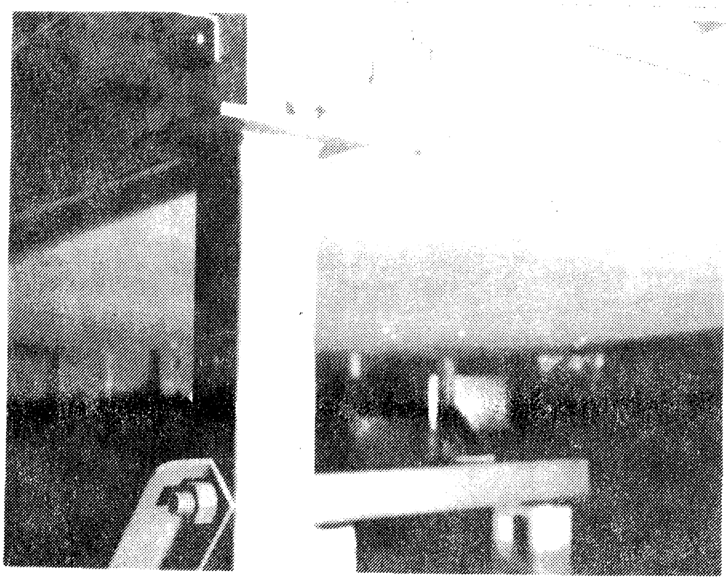


FIGURE 2

NODAL LOCATIONS FOR APPLICATION OF CONCRETE BLOCKS SIMULATING U.D. LOAD

3.3 Plywood/Gyprock Sheathed

After completion of the testing program outlined in Section 3.2 the floor system was sheathed on its underside with gyprock as shown in Plate 9. Fixing of the gyprock was done with the floor remaining positioned on its sub–floor, within the Loading Frame.



Shows the Floor with Gyprock Ceiling Connected

Plate 9

The load cases considered for this construction were the same as for the "plywood sheathed only" case as well as:

- evaluation of the **resonant frequency** when the floor was **subjected to 1/3 of the live load** taken to represent the dead load due to furniture, etc.

The purpose of the above test was to investigate the influence of damping on the resonant frequency.

4. TEST RESULTS

Appendices 1 and 2 respectively contain the load/deflection data obtained for the floor system when:

- plywood sheathed only
- plywood/gyprock sheathed.

4.1 Plywood Sheathed Only

Table A1.1 gives the load/deflection data due to loading each of the identified nodes individually with a 1.8 kN concentrated load. After a preload, the 1.8 kN was applied directly and the deflections monitored. Following unloading the residual deflection at the loaded node was noted.

Table A1.2 gives the load/deflection data resulting from the application of the "restricted area loading" to the centre joist by means of discrete concrete blocks. The blocks were applied to the floor in three increments indicated by the load cases 2, 3 and 4. Deflections were monitored after each load application. A total load of 5.34 kN (5.34/0.48 x 3.6 = 3 kPa) was held for five minutes and the deflections again taken. The load was removed and deflections immediately monitored.

Table A1.3 tabulates the load/deflection results obtained during application of the simulated 1.5 kPa live loading. The u.d. loading simulation was again by means of concrete blocks applied in three increments. After each loading increment deflections were measured at the nodes indicated. The load was maintained for five minutes and the creep deflections noted. The loading was removed and the residual deflections were monitored.

Resonant frequencies for the system were determined for the shaker located at:

- nodes 5, 11 and the quarter point of joist $\overline{10,12}$.

Figure 3 shows a plot of the amplitude of motion (mm) of node 11 versus system frequency for the shaker positioned at node 11. For each position of the shaker the floor was unloaded.

4.2 Plywood/Gyprock Sheathed

Tables A2.1, A2.2 and A2.3 give the load/deflection data for the three loading conditions discussed in Section 4.1, except in this case the underside of the floor was sheathed with 10 mm thick gyprock.

Figure 3 also gives a plot of the amplitude of displacement versus system frequency for the shaker located at node 11 as for the plywood sheathed only case.

To attempt to account for the influence on floor dynamics of loads due to furniture, etc. approximately one–third of the 1.5 kPa u.d. loading was left on the floor when it was being unloaded. The shaker was placed at node 11, i.e. floor system mid–span, and the amplitude/frequency response plotted as shown in Figure 3. This was considered to be a particularly important case since any increase in mass without a resultant increase in system stiffness inevitably causes a reduced resonant frequency.

DYNAMIC RESPONSE OF 3.6 x 3.6 m PLYWOOD SERVICES FLOOR SYSTEM

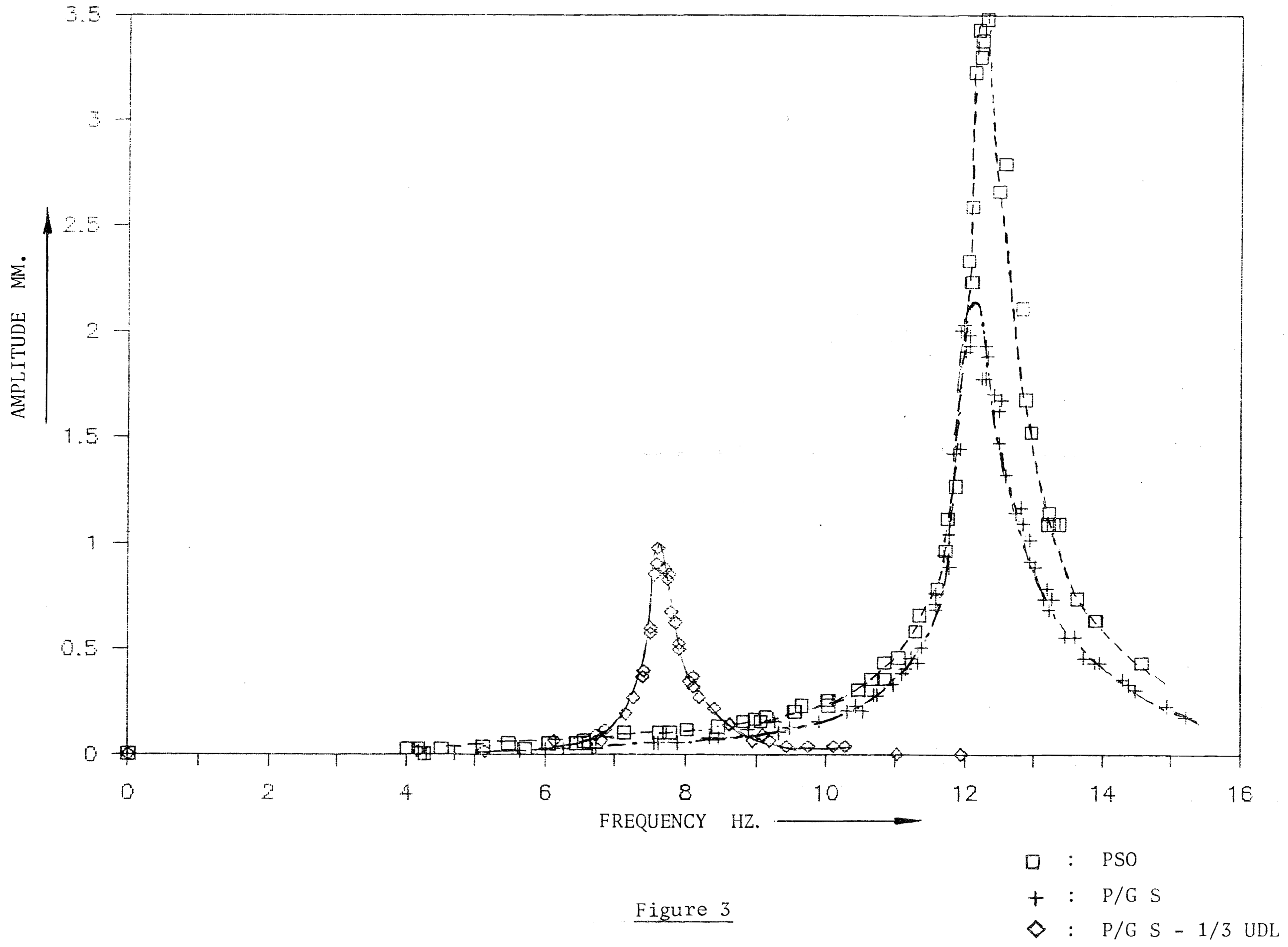


Figure 3

DEFLECTIONS FOR PLYWOOD ONLY AND PLY/GYPROCK SHEATHED FLOOR SYSTEMS

PLYWOOD SHEATHED ONLY										PLYWOOD/GYPROCK SHEATHED									
LOAD CASE	LOADED NODE/S	MID-SPAN DEFLECTION AT:								LOAD CASE	LOADED NODE/S	MID-SPAN DEFLECTION AT:							
		BEARER NODES (mm)		JOIST NODES (mm)								BEARER NODES (mm)		JOIST NODES (mm)					
		10	12	23	5	11	17	22				10	12	23	5	11	17	22	
1.8 kN Conc.	10	3.35	-	-	1.00	1.63	1.00	-		1.8 kN Conc.	10	2.32	-	-	0.73	1.30	0.77	-	
	12	-	3.15	-	0.97	1.70	1.05	-			12	-	2.28	-	0.72	1.27	0.78	-	
	11	1.65	1.70	-	1.05	4.20	1.10	-			11	1.30	1.20	-	0.90	3.37	0.97	-	
	22	-	-	-	-	-	-	3.45			22	-	-	-	-	-	-	2.80	
	23	-	-	3.0	-	-	-	-			23	-	-	2.41	-	-	-	-	
Restricted Area udl 2.5 kPa	27 thru 32	5.02	5.13	-	2.92	9.55	3.35	-		Restricted Area udl 2.5 kPa	27 thru 32	3.92	4.15	-	2.63	7.69	2.77	-	
1.5 kPa Live Load	all	12.61	12.96	1.60	12.02	18.19	13.44	1.68		1.5 kPa Live Load	all	10.05	11.10	2.01	9.78	14.47	10.68	2.25	

Table 1

4.3 Reduced Data

Table 1 gives the load/deflection results for:

(a) plywood sheathed only
- 1.8 kN concentrated load applied at mid–span of bearers, two edge and the centre joists;
- 3 kPa restricted area u.d. loading applied to the centre joist;
- 1.5 kPa u.d. loading applied to the entire floor area.

(b) plywood/gyprock sheathed
- each of the three load cases in (a) above.

For ease of comparison of member response, bearer and joist nodal deflections have been separated, for each of the two construction cases.

In Table 2 bearer and joist deflections have been compared for:

- each of the three load cases;
- the plywood sheathed only and the plywood/gyprock sheathed constructions.

The plywood sheathed only (PSO) case has been normalised (reduced to unity) for each loading to allow the contribution to member stiffness due to sheathing with the gyprock to be quantified.

Deflection Comparison for Plywood Only and Ply/Gyprock Sheathed Floor System

LOAD CASE	NORMALISED MEMBER MID–SPAN DEFLECTIONS									
	BEARERS				JOISTS					
	Right End		Left End		PSO	P/G S	PSO	P/G S	PSO	P/G S
	PSO*	P/G S*	PS	P/G S	10,12	10,12	Containing 22		Containing 23	
1.8 kN conc. load	1.00	0.69	1.00	0.72	1.00	0.85	1.0	0.81	1.00	0.80
Restr–icted Area Loading	1.00	0.78	1.00	0.81	1.00	0.81	–	–	–	–
1.5 kPa live	1.00	0.84	1.00	0.86	1.00	0.72	1.00	1.25	1.00	1.34

Note: PSO = plywood sheathed only
P/G S = ply/gyprock sheathed

Table 2

For a direct comparison the member deflection corresponding to the particular loading condition for the P/G S case was divided by the actual deflection for the PSO case. Following this procedure Table 2 shows the **bearer stiffness** was increased by:

- approximately 30% for the 1.8 kN concentrated loads;
- about 20% under the restricted area u.d. loading;
- 15% for the 1.5 kPa simulated live loading.

For the **centre joist** the **stiffening** trend due to the concentrated and 1.5 kPa u.d. loading is reversed, i.e.:

- 15% for the 1.8 kN concentrated load;
- 20% for the restricted area loading;
- 28% for the 1.5 kPa u.d. loading.

For the 1.5 kPa loading, which is the most severe, the PSO construction implies **two–way action** has been somewhat negated, i.e., some of the tendency for the bearer to shed load to joists, through the sheathing, is partially cancelled by the joists doing likewise. Hence, as far as the **bearers** are concerned their lateral load transfer capabilities are most effective under concentrated loads, i.e. when the **joists are unloaded.**

Edge joist (containing nodes 22 and 23) response to the 1.5 kPa loading infers a reduction in stiffness. That is, **edge joist deflections were increased.** This in turn shows the gyprock sheathing has enhanced the lateral load transfer capabilities of the joists.

Table 3 gives the actual bearer and centre joist deflections for the PSO and P/G S cases. The **deflection ratios** have also been evaluated and included in the table for ease of further reference.

Comparison of Absolute Bearer and Joist Deflections for 1.5 kPa Live Load

Floor Description	BEARER		CENTRE JOIST	
	Average Defln (mm)	Defln Ratio	Absolute Defln (mm)	Defln Ratio
PSO	12.78	L/282	5.41	L/665
P/G S	10.58	L/340	3.89	L/925

Table 3

5. CONCLUSIONS

For a timber floor to be deemed satisfactory from a **performance** viewpoint it is necessary for its elements to satisfy certain accepted **serviceability criteria** when interconnected to produce the system.

Total floor system response must be considered when a testing program is performed on the structure to evaluate its performance characteristics. This approach allows the contribution to stiffness made by connecting the sheathing to the beam elements (bearers and joists) to be included. Realistically accounting for the contribution of the sheathing and its enhancement of structural performance is difficult, if not impossible, using normal analytical techniques.

In this day and age any testing program performed on a floor must also include consideration of the dynamic response of the system. In particular, floors which vary from standard construction techniques, and have fairly large spans, offer no guarantee that satisfying static deflection limitations will ensure satisfactory dynamic performance. Since the human body has a major resonant frequency found to be about 5 Hz (2), it is essential that any floor should have a somewhat higher natural frequency than this value.

How much higher floor system natural frequency should be above the human comfort limit is fairly subjective. However, one would expect that provided it was, say 50% greater, when most severely damped, it should be satisfactory. For a floor without walls, etc. attached, a simulated "worst" case would be when the floor was subjected to the estimated dead load due to furniture, etc. For purposes of this testing program this loading was assumed to be approximately 0.5 kPa.

Table 4 gives suggested serviceability limit states on stiffness (3) and dynamic response, together with a minimum value for the ultimate limit states. The bound placed on dynamic behaviour and ultimate load carrying capabilities are suggested by the writer.

Suggested Limit States

Short Term Response			**Long Term Response**		**Ultimate Limit State**
Static Deflns		**Dynamic Behaviour**	**Static Defln**		
Bearer	**Joist**	**System**	**Bearer**	**Joist**	**System Response**
L/360 or not greater than 9 mm (3)	L/360 or not greater than 9 mm (3)	> 7.5 Hz for 1/3 live load	L/300 or not greater than 12.5 mm (3)	L/300 or not greater than d12.5 mm (3)	2 to 3 x Design Load for first failure

Table 4

Although only one test was performed, the floor system results will be of significance provided the:

- plywood used to manufacture the joists conformed to a properly controlled quality control program;
- gyprock manufacture was subject to the same controls as the plywood;
- joist construction was done under controlled factory conditions;
- bearers would be specified as stress graded material;
- construction techniques used to assemble the floor were only those expected to be encountered in normal building practice;
- support conditions develop at least the absolute minimum conditions of fixity.

With reference to **dynamic response** the following results may be observed from Figure 3:

- The fundamental frequency of floor vibration under no load is in the range of 12 to 12.5 Hz.

  Attaching a gyprock sheeting to the underside of the floor does not alter the system's resonance frequency.
- Gyprock has a significant damping effect on the floor's dynamic behaviour as evidenced by the large reduction of floor vibration amplitude at the resonance frequency.
- Applying a 0.5 kPa u.d. loading to the gyprock sheathed floor resulted in lowering the resonance frequency from 12 Hz to approximately 8 Hz, as well as further suppressing the amplitude of vibration.
- When the shaker was located off–centre on the floor it resulted in no change in resonance frequencies, however the tendency towards reduced vibration amplitudes at floor centre was observed.

5.1 Recommendations

Recommendations will be considered with respect to either **system** or **bearer/joist response** to each of the following

- ultimate limit state;
- long term response characteristics;
- short term serviceability limit states.

5.1.1 Ultimate Limit State

The floor panel was not failed during this series of tests in order to establish an ultimate limit state. Since the floor constitutes a "new" system, it was decided to store it for the time being, in case other tests were considered necessary.

5.1.2 Long Term Response

All tests performed on the floor in this program involved short duration loading. Therefore, no attempt is made herein to extrapolate the results to account for long term effects.

5.1.3 Short Term Serviceability Limit States

Table 5 gives the short term serviceability data for the floor system sheathed both sides. This data is compared with the suggested values for bearer and joist deflections (3) under 1.5 kPa u.d. live loading and the resonant frequency of the system when subjected to 1/3 of the u.d. live load simulating long term dead conditions.

Comparison of Serviceability Limit States

SHORT TERM RESPONSE					
Suggest Allow. Static Deflns		**Measured Static Deflns.**		**Dynamic Behaviour**	
Bearer	**Joist**	**Bearer**	**Joist**	**Suggested Frequency**	**Measured Frequency**
> 9 mm L/360	> 9 mm L/360	10.58 mm L/340	3.89 mm L/925	> 7.5 Hz for 1/3 u.d. live load	~ 8 Hz

Table 5

From Table 5 it can be seen the short term requirements are satisfied for:

- joist stiffness
- system dynamic response.

Bearer stiffness is low by 17.5% based on absolute deflection requirements and by some 6% in terms of deflection ratios. Increasing the width of the bearer from 35 mm wide to 45 mm wide increases the second moment of area by 28.5%, which is more than enough. Other alternatives for increasing bearer stiffness include:

- increasing depth by 20 mm to 220 mm resulting in a 33% increase in stiffness;

- using F14 bearers rather than F8, which would increase the Modulus of Elasticity (MoE) by 37%;

- any sort of reasonable connection between the floor and its supports would increase its stiffness.

5.2 Final Comments

the floor system was reasonably simple to construct and when completed had a pleasing appearance. Generally, short term load response characteristics were satisfactory, bearer performance excluded. However, the discussion concerning the bearers' deficiencies shows they would be easily rectified.

6. REFERENCES

1. SAA "Dead and Live Load", AS1170, Part 1.

2. Vibrations of Floors – A Literature Review. L. Whale, Timber Research and Development Association, England, 1983.

3. Low–Rise Domestic and Similar Framed Structures, Part 1. Design Criteria (Revised). CSIRO, Division of Building Research – Special Report. G.F. Reardon and N.H. Kloot, 1978.

APPENDIX 1

Load/deflection data for the floor system sheathed with plywood only.

FIRM: PLYWOOD SERVICES PTY LTD
FLOOR IDENTIFICATION: 3·6 x 3·6 m P.S. LOW PROFILE FLOOR
TYPE OF LOADING: Concentrated Load of 1·8 kN/node (plywood sheathed only)
DATE TESTED: 13-7-88

LOADED NODE	LOAD (kN)	NODAL DEFLECTIONS (mm) — DIAL GAUGE POSITIONS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
10	1·8				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00
					2·05	1·00	0·00				3·35	1·63	-0·03				2·15	1·00	0·00				-0·05	0·00
											0·25													
12	1·8				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00
					0·00	0·97	2·00				-0·05	1·70	3·15				0·02	1·05	2·13				-0·04	0·00
													0·18											
11	1·8				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00
					1·00	1·05	1·00				1·65	4·20	1·70				1·08	1·10	1·05				-0·08	0·00
												0·20												
22	1·8				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00
					-0·05	-0·07	1·10				-0·07	-0·12	-0·18				-0·10	0·07	-0·13				3·45	0·00
																							0·15	
23	1·8				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00
					0·01	0·03	0·05				0·00	-0·07	-0·06				-0·08	-0·05	-0·03				-0·05	3·00

LOAD/DEFLECTION DATA SHEET

TABLE A1·1

LOAD/DEFLECTION DATA SHEET

TABLE A1·1

FIRM: PLYWOOD SERVICES PTY LTD
FLOOR IDENTIFICATION: 3·6 x 3·6m P.S. LOW PROFILE FLOOR
TYPE OF LOADING: Restricted Area U.D. Loading on Centre Joist (2·5kPa) (plywood sheathed only)
DATE TESTED: 8-7-88

NODE	LOAD/NODE FOR LOAD CASES:				NODAL DEFLECTIONS (mm) FOR LOAD CASES 1 THRU 4 — DIAL GAUGE POSITIONS											
	1	2	3	4	4	5	6	10	11	12	16	17	18	22	23	
27	0	333			0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	
28	0	330	500		1·20	1·01	1·19	2·10	3·45	2·02	1·20	1·25	1·27	-0·08	-0·06	
29	0	329	513	164	2·70	2·57	2·67	4·50	8·27	3·55	2·75	2·95	2·88	-0·17	-0·08	
30	0	332	491	179	3·03	2·92	3·03	5·02	9·55	5·13	3·10	3·35	3·22	-0·18	-0·06	
31	0	326	503	171	3·14	3·01	3·11	5·17	9·79	5·25	3·18	3·45	3·33	-0·19	-0·06	5 mins. after loading
32	0	329	509		0·08	-0·24	0·09	0·30	0·25	0·15	-0·06	0·05	0·01	-0·06	-0·08	immediately after unloading
33	0	331														

LOAD/DEFLECTION DATA SHEET

TABLE A1·2

FIRM: PLYWOOD SERVICES PTY LTD
FLOOR IDENTIFICATION: 3·6x3·6m P.S. LOW PROFILE FLOOR
TYPE OF LOADING: 1·5 kPa U.D. Loading (plywood sheathed only)
DATE TESTED: 8-7-88.

NODE	LOAD/NODE FOR LOAD CASES:				NODAL DEFLECTIONS (mm) FOR LOAD CASES 1 TO 4 — DIAL GAUGE POSITIONS																						
	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	0	165						0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00
2	0	168																									
3	0	164						3·11	4·48	3·12				4·80	6·48	4·95				2·27	5·00	3·27				1·32	1·21
4	0	165																									
5	0	167						5·76	8·48	5·82				8·80	12·36	9·09				6·50	9·50	6·06				1·71	1·56
6	0	164																									
7	0	162	180					8·21	12·02	8·15				12·61	18·19	12·96				8·36	13·44	8·60				1·68	1·60
8	0	167	170																								
9	0	157	169					8·58	12·40	8·45				13·10	18·57	13·44				9·00	14·03	8·98				1·70	1·60
10	0	166	169																								
11	0	164	158					0·92	1·28	0·77				1·40	2·05	1·35				0·90	1·50	0·85				0·10	0·22
12	0	164																									
13	0	156																									
14	0	159	179	178																							
15	0	159	177	163																							
16	0	157	177	178																							
17	0	166	163	179																							
18	0	165	178	180																							
19	0	164																									
20	0	167																									
21	0	166	158	158																							
22	0	165	165	161																							
23	0	159	170	179																							
24	0	165	171	180																							
25	0	165	167	157																							
26	0	164																									
27	0	166																									
28	0	164	169	180																							
29	0	165	169	160																							
30	0	167	164	180																							
31	0	160	179	182																							
32	0	166	161	180																							
33	0	165																									
34	0	166																									
35	0	169	158	180																							
36	0	165	162	177																							
37	0	163	170	180																							
38	0	165	170	180																							
39	0	165	171	161																							
40	0	161																									
41	0	167																									
42	0	170	165	178																							
43	0	164	170	180																							
44	0	165	170	179																							
45	0	179	179	161																							
46	0	164	163	180																							
47	0	167																									
48	0	165																									
49	0	159	180																								
50	0	165	168																								
51	0	164	171																								
52	0	159	164																								
53	0	166	169																								
54	0	165																									
55	0	165																									
56	0	164																									
57	0	165																									
58	0	165																									
59	0	162																									

LOAD/DEFLECTION DATA SHEET

TABLE A1·3

APPENDIX 2

Load/deflection data for the floor system sheathed with plywood/gyprock.

FIRM: PLYWOOD SERVICES PTY LTD
FLOOR IDENTIFICATION: 3·6 x 3·6 m P.S. LOW PROFILE FLOOR
TYPE OF LOADING: Concentrated Load of 1·8kN/node (Plywood/Gyprock sheathed)
DATE TESTED: 20-7-88

LOADED NODE	LOAD (kN)	NODAL DEFLECTIONS (mm) DIAL GAUGE POSITIONS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
10	1·8				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00
					1·37	0·73	0·13				2·32	1·30	0·29				1·44	0·77	0·18				-0·05	0·0
											0·30													
12	1·8				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00
					0·18	0·72	1·28				0·27	1·27	2·28				0·20	0·78	1·33				-0·09	0·00
													0·18											
11	1·8				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00
					0·80	0·90	0·75				1·30	3·37	1·20				0·88	0·97	0·80				-0·04	0·00
												0·30												
22	1·8				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00
					-0·07	-0·07	-0·10				0·00	-0·12	-0·07				-0·07	0·32	-0·04				2·80	0·00
																							0·20	
23	1·8				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00	0·00				0·00	0·00
					-0·05	0·23	0·00				-0·05	-0·05	-0·12				-0·05	-0·05	0·0				-0·08	2·41
																								0·15

LOAD/DEFLECTION DATA SHEET

TABLE A2.1

FIRM: PLYWOOD SERVICES PTY LTD
FLOOR IDENTIFICATION: 3·6x3·6 m P.S. LOW PROFILE FLOOR
TYPE OF LOADING: Restricted Area U.D. Loading on Centre Joist (2·5kPa)
DATE TESTED: 21-7-88 (plywood/gyprock sheathed)

NODE	LOAD/NODE FOR LOAD CASES:				NODAL DEFLECTIONS (mm) FOR LOAD CASES 1 THRU 4 — DIAL GAUGE POSITIONS											
	1	2	3	4	4	5	6	10	11	12	16	17	18	22	23	
27	0	316	'		0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	0·00	
28	0	330	507		0·91	1·00	0·95	1·56	2·90	1·72	0·93	1·10	1·00	-0·15	0·00	
29	0	329	497	167	2·06	2·33	2·00	3·47	6·84	3·68	2·17	2·46	2·15	-0·18	0·00	
30	0	328	501	161	2·32	2·63	2·35	3·92	7·69	4·15	2·44	2·77	2·45	-0·15	0·05	
31	0	335	494	167	2·40	2·70	2·43	4·04	7·97	4·27	2·50	2·85	2·50	-0·15	0·05	5 min. after loading
32	0	341	504		0·18	0·14	0·20	0·30	0·60	0·37	0·14	0·20	0·20	0·00	0·00	immediately after unloading
33	0	362							0·40							5 min. after unloading.

LOAD/DEFLECTION DATA SHEET

TABLE A2.2

FIRM: PLYWOOD SERVICES PTY LTD
FLOOR IDENTIFICATION: 3.6 x 3.6 m P.S. LOW PROFILE FLOOR
TYPE OF LOADING: 1.5 kPa U.D. Loading (plywood/gyprock sheathed)
DATE TESTED: 21-7-88

NODE	LOAD/NODE FOR LOAD CASES:				NODAL DEFLECTIONS (mm) FOR LOAD CASES 1 TO 4 — DIAL GAUGE POSITIONS																						
	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	0	170						0.00	0.00	0.00				0.00	0.00	0.00				0.00	0.00	0.00				0.00	0.00
2	0	169																									
3	0	164						2.45	3.75	2.46				3.70	5.28	4.82				2.60	4.04	2.53				1.29	1.2
4	0	170																									
5	0	182						4.55	6.90	4.50				7.00	9.90	8.05				4.80	7.55	4.70				1.95	1.6
6	0	159																									
7	0	178	166					6.56	9.78	6.47				10.05	14.47	11.10				6.67	10.68	6.74				2.25	2.0
8	0	165	169																								
9	0	176	160					6.63	9.99	6.66				10.27	14.81	11.38				6.85	10.97	6.91				2.31	2.0
10	0	163	161																								
11	0	179	180					2.70	4.00	2.70				4.00	5.55	5.15				2.80	4.35	2.70				1.50	0.9
12	0	180																									
13	0	157						APPROX. 1/3 OF LOAD LEFT ON FLOOR TO																			
14	0	164	168	158				SIMULATE DEAD LOAD FOR DYNAMIC																			
15	0	164	164	162				TESTS																			
16	0	165	180	160																							
17	0	165	166	180																							
18	0	180	161	169																							
19	0	164																									
20	0	159																									
21	0	171	161	165																							
22	0	164	163	161																							
23	0	165	169	157																							
24	0	171	170	180																							
25	0	165	177	166																							
26	0	166																									
27	0	178																									
28	0	165	167	164																							
29	0	182	162	158																							
30	0	167	179	164																							
31	0	179	178	180																							
32	0	166	167	177																							
33	0	159																									
34	0	170																									
35	0	165	164	156																							
36	0	165	162	165																							
37	0	165	165	165																							
38	0	159	177	180																							
39	0	157	165	167																							
40	0	163																									
41	0	165																									
42	0	179	167	167																							
43	0	164	170	158																							
44	0	178	167	180																							
45	0	161	164	180																							
46	0	163	164	180																							
47	0	165																									
48	0	180																									
49	0	168	169																								
50	0	165	165																								
51	0	164	166																								
52	0	158	179																								
53	0	171	179																								
54	0	159																									
55	0	166																									
56	0	170																									
57	0	170																									
58	0	165																									
59	0	179																									

LOAD/DEFLECTION DATA SHEET

TABLE A2.3