Herriot-Watt University

Department of Building

Technical Report on Sempafloor

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T E C H N I C A L R E P O R T

Report No: 003/90

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Head of Department:
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Date: 3rd September 1991

SUBJECT: Measurement of The Impact Sound Insulation Of Sempafloor, With and Without Surface Materials, on a Range of Structural Floors.

Brief for Consultancy: To Measure The Impact Sound Insulation of Sempafloor, With and Without Surface Materials, On A Range of Structural Floors.

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R E P O R T

1.0 INTRODUCTION

1.1 This Report presents details of a series of measurements which have been undertaken during the last few months to determine the Impact Sound Insulation qualities of Sempafloor when placed on a conventional timber suspended floor or on a concrete suspended floor. Sempafloor was then used as a base material for a number of floor finishes which were then tested for impact sound.

1.2 The tests were carried out over a period of time by David J. MacKenzie BSc., MSc., MIOA from Heriot-Watt University assisted by Mr. W. J. R. Orr BSc.

2.0 DESCRIPTION OF TEST FLOORS

2.1 General

The tests can be split up into two distinct groups:

a. Test floor within the Department of Building, and

b. Test floors within existing buildings.

2.2 Test Floor Within The Department of Building

Many of the impact sound insulation tests undertaken on Sempafloor have been carried out under controlled conditions within the vertical sound transmission suite laboratory at Heriot-Watt University in Edinburgh. This suite comprises a number of specialised rooms, but in particular, the vertical suite has one room above another the floor of which can be removed and replaced with the floor under test. However, in this instance the structural floor remained the same with the surface material being changed to suit the test being carried out at that time.

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2.3 Test Floors Within Existing Buildings

Some data has been gathered of the impact sound insulation of floors within existing buildings prior to the laying of Sempafloor with a follow-up test to determine whether any difference in the insulation was achieved.

A general description of the test floor will be given for each result.

3.0 AIRBORNE and IMPACT SOUND INSULATION

3.1 When undertaking a sound insulation test in a property it is usual to measure the airborne sound insulation as well as the impact sound insulation of a separating floor. Obviously for the element under test to meet The Building Standard (Scotland) Amendment Regulations 1987, the sound insulation of the floor must meet both of the stated criteria.

3.2 Under this series of tests it is only the impact sound insulation that is considered. It is accepted that the improvement to the airborne sound insulation achieved by the layer of Sempafloor would be very small, if any, and so was not measured during the laboratory based tests.

3.3 Some further information on this is given in my previous Technical Report No. 006/88.

4.0 EQUIPMENT USED

4.1 The equipment used conformed to the requirements of BS 2750 1980, "Methods of Measurement of Sound Insulation in Buildings and of Building Elements", and in particular, the following parts:

a. BS 2750: Part 4: 1980 "Field Measurements of Airborne Sound Insulation Between Rooms", and

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b. BS 2750: Part 7: 1980 "Field Measurements of The Impact Sound Insulation of Floors".

4.2 The following items of equipment were used to carry out the Airborne and Impact Sound Insulation tests -

Bruel and Kjaer Sound Measuring System
Bruel and Kjaer Loudspeaker System
Bruel and Kjaer Tapping Machine
Bruel and Kjaer Condenser Microphones
Bruel and Kjaer Cathode Followers, etc.

plus various other ancillary equipment for calibration etc.

5.0 MEASUREMENT PROCEDURE

5.1 The test procedure conformed to the requirements set out under Clause H3 and H4 of The Building Standards (Scotland) Regulations 1981, The Building Standards (Scotland) Amendment Regulations 1987 and to the recommendations contained within the above mentioned BS 2750:1980.

6.0 RESULTS

6.1 Comment

On 21 st. September 1987 The Building Standards (Scotland) Amendment Regulations 1987 came into force. Instead of using the former AAD method of determining whether a wall or floor meets the criterion, a new single figure method, calculated according to BS 5821: "Rating The Sound Insulation in Buildings and of Building Elements" must be determined for both the airborne and impact sound insulation.

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6.2 Single Figure Ratings to BS 5821

For the presentation of sound insulation test results, reference is made to the following Parts of BS 5821: 1984 -

Airborne Sound: Part 1. "Method for Rating .The Airborne Sound Insulation in Buildings and of Interior Building Elements", and

Impact Sound: Part 2. "Method for Rating The Impact Sound Insulation".

The following table gives the acceptable values for the weighted standardised level difference [airborne sound] and the weighted standardised impact sound pressure level [impact sound].

	Mean Value	Any Individual Value
Airborne Sound : minimum values of weighted standardised level difference ($D_{nT,w}$) :		
Walls	53	49
Floors	52	48
Impact Sound : maximum values of weighted standardised impact sound pressure level ($L'_{nT,w}$) :		
Floors	61	65

Note: For airborne sound a higher single figure rating, compared with the recommended values, indicates a better airborne sound insulation.

For impact sound a lower single figure rating, compared with the recommended values, indicates a better impact sound insulation.

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6.3 The Building Standards (Scotland) Amendment Regulations 1987

Part III, 'Performance Standards and Test Procedures' of the above Regulations give details of the performance standards which the elements tested must achieve. Section 2, part vii states that 'where only two or three sets of measurements have been possible the mean must still be reached, and where only one set is possible the value achieved must not be worse than the mean value'.

7.0 RESULTS

7.1 Test Floor Within The Department of Building

The first series of results are for a range of tests that have been undertaken on a test floor within the laboratory. The exact details of the floor are not known, however the results are useful for comparison.

Test Series A

This first set of results shows the improvement of laying a single layer of Sempafloor on a solid concrete floor, the details of which are not known.

Material Description	L'_{nTw}
a. Bare concrete floor	72
b. Timber floor on 25 mm glassfibre quilt	46
d. Timber floor on Sempafloor layer	45

The timber floating layer in this case was 19 mm thick chipboard, 1 metre square fixed to three timber battens 45 x 45 mm section.

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With a maximum permissible L'_{nTw} of 61 dB, the improvement in the impact sound insulation is excellent.

Test Series B

This first set of results shows the improvement of laying a single layer of Sempafloor on a Bison prestressed precast 150 mm thick concrete floor with no screed. The slab is 240 kg per square metre, 1600 kg per cubic metre.

Material Description		L'_{nTw}
a.	Bare concrete floor	76
b.	Sempafloor layer only (no timber floating floor)	54
c.	Foam backed carpet on concrete floor	50
d.	Foam backed carpet on Sempafloor on concrete	43
e.	Axminster carpet on concrete floor	54
f.	Axminster carpet on Sempafloor on concrete	44
g.	Hard foamed backed carpet on concrete	47
h.	Hard foamed backed carpet on Sempafloor on conc.	43
i.	Vinyl flooring on Sempafloor on concrete	53
j.	Cushionfloor on Sempafloor on concrete	48
k.	6 mm Sterling board on Sempafloor on concrete	56
l.	6 mm Plywood on Sempafloor on concrete	53
Chipboard Flooring on Timber Battens on Resilient Layer		
m.	Timber floating floor on Sempafloor on concrete	58
n.	Sempafloor on floating layer on Sempatap	46

The above have been graphed and are shown in Figures 1 to 8 inclusive. A brief description of each follows:

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Figure 1: Impact sound insulation of bare concrete floor compared with a single layer of Sempafloor.

Figure 2: Impact sound insulation of foam backed carpet on bare concrete floor compared with the same carpet placed on a single layer of Sempafloor.

Figure 3: Impact sound insulation of hessian backed Axminster carpet with no underlay on bare concrete floor compared with the same carpet on a single layer of Sempafloor.

Figure 4: Impact sound insulation of hard foam backed carpet on a single layer of Sempafloor compared with a nylon, hessian backed carpet on a single layer of Sempafloor.

Figure 5: Impact sound insulation of vinyl flooring on a single layer of Sempafloor compared with cushionfloor on a single layer of Sempafloor.

Figure 6: Impact sound insulation of a 6 mm thick layer of Sterling board laid on a single layer of Sempafloor compared with a 6 mm layer of plywood on a single layer of Sempafloor.

Figure 7: Impact sound insulation of a floating timber floor on a single layer of Sempafloor compared with a single layer of Sempafloor.

Figure 8: Impact sound insulation of a floating timber floor on a single layer of Sempafloor compared with Sempafloor on a floating layer on a single layer of Sempatap.

The timber floating layer in this case was 19 mm thick chipboard, 1 metre square fixed to three timber battens 45 x 45 mm section.

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Test Series C

This first set of results shows the improvement of laying a single layer of Sempafloor on a Bison prestressed precast 150 mm thick concrete floor with no screed. Same floor as in Test Series B.

	Material Description	L'_{nTw}
a.	Bare concrete floor	76
b.	6 mm Sterling board on Sempafloor on concrete	56
c.	6 mm Plywood on Sempafloor on concrete	56
d.	F. B. Carpet on Sterling bd. on Sempafloor	45
e.	F. B. Carpet on Plywood on Sempafloor	44
f.	Axm. carpet on treadair on Sterling on Sempafloor	33
g.	Axm. carpet on treadair on plywood on Sempafloor	33
h.	Cushionfloor on Sterling board on Sempafloor	54
i.	Cushionfloor on plywood on Sempafloor	52

Chipboard Flooring on Timber Battens on Resilient Layer

j.	Timber floor on concrete floor (no resilient lyr)	64
k.	Timber floor on Sempafloor on concrete	57
l.	Timber floor plus 80 kgs on Sempafloor on conc.	61
m.	Timber floor on insulation quilt on concrete	52
n.	Sempafloor on timber floor on insulation quilt	43

The above have been graphed and are shown in Figures 9 to 14 inclusive. A brief description of each follows:

Figure 9: Impact sound insulation of Sterling board on a single layer of Sempafloor compared with plywood on a single layer of Sempafloor.

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Figure 10: Impact sound insulation of foam backed carpet on Sterling board on a single layer of Sempafloor compared with the same carpet placed on plywood on a single layer of Sempafloor.

Figure 11: Impact sound insulation of hessian backed Axminster carpet with treadair underlay on Sterling board on a single layer of Sempafloor compared with the same carpet on treadair underlay on plywood on a single layer of Sempafloor.

Figure 12: Impact sound insulation of cushionfloor on Sterling board on a single layer of Sempafloor compared with cushionfloor on plywood on a single layer of Sempafloor.

Figure 13: Impact sound insulation of a floating timber floor laid directly on the concrete floor with no resilience compared with the floating floor laid on a single layer of Sempafloor compared with the floating layer on a single layer of Sempafloor with a loading of 80 kgs. on the surface.

Figure 14: Impact sound insulation of a floating timber floor laid directly on the concrete floor with no resilience compared with the floating floor laid on a layer of glass fibre insulation quilt compared with a single layer of Sempafloor laid on the floating layer on the glass fibre quilt.

The timber floating layer in this case was 19 mm thick chipboard, 1 metre square fixed to three timber battens 45 x 45 mm section.

7.2 Tests Within Existing Buildings

Test Series D

This series of test results has been carried out on an existing tenement building which had just been refurbished. The floor is of traditional Edinburgh timber construction.

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A comparison was carried out of a variety of floor finishes laid on top of the existing timber flooring.

	Material Description	L'_{nTw}
a.	Bare timber floor	64
b.	Sempafloor layer only (no timber floating floor)	57
c.	Foam backed carpet on timber floor	54
d.	Foam backed carpet on Sempafloor on timber	46
e.	Axminster carpet on timber floor	56
f.	Axminster carpet on Sempafloor on timber	48
g.	Hard foamed backed carpet on Sempafloor on timber	51
h.	Nylon, hard foam backed carpet on Sempafloor	47
i.	Vinyl flooring on Sempafloor on timber	59
j.	Cushionfloor on Sempafloor on timber	53
k.	6 mm Sterling board on Sempafloor on timber	60
l.	6 mm Plywood on Sempafloor on timber	55
	Chipboard Flooring on Timber Battens on Resilient Layer	
m.	Timber floating floor on Sempafloor on timber	58
n.	Sempafloor on floating layer on Sempafloor	52

The above have been graphed and are shown in Figures 15 to 21 inclusive. A brief description of each follows:

Figure 15: Impact sound insulation of bare timber floor compared with a single layer of Sempafloor.

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Figure 16: Impact sound insulation of foam backed carpet on bare timber floor compared with the same carpet placed on a single layer of Sempafloor.

Figure 17: Impact sound insulation of hessian backed Axminster carpet with no underlay on bare timber floor compared with the same carpet on a single layer of Sempafloor.

Figure 18: Impact sound insulation of hard foam backed carpet on a single layer of Sempafloor compared with a nylon, hessian backed carpet on a single layer of Sempafloor.

Figure 19: Impact sound insulation of vinyl flooring on a single layer of Sempafloor compared with cushionfloor on a single layer of Sempafloor.

Figure 20: Impact sound insulation of a 6 mm thick layer of Sterling board laid on a single layer of Sempafloor compared with a 6 mm layer of plywood on a single layer of Sempafloor.

Figure 21: Impact sound insulation of a floating timber floor on a single layer of Sempafloor compared with a single layer of Sempafloor on the floating layer on the Sempafloor.

The timber floating layer in this case was 19 mm thick chipboard, 1 metre square fixed to three timber battens 45 x 45 mm section.

7.3 Completed Projects

This next set of results are a range of projects in which measurement of the impact sound insulation of the separating floor has been determined before and after Sempafloor was laid. Each has a graph explaining the result.

Concrete Floors

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Leith

In this particular project, the existing concrete floor was tested for impact sound, which failed; a single layer of Sempafloor was layed with a layer of plywood (6 mm) over for protection purposes. The floor was retested and passed the regulations satisfactorily.

Material Description	L'_{nTw}
a. Bare concrete floor (Living Room/Living Room)	63
b. Plywood on Sempafloor on above floor (LR/LR)	50

Figure 22: Comparison of the impact sound insulation of the above two sets of results showing the difference in the insulation value of the bare concrete floor after Sempafloor has been laid. The layer of plywood over the Sempafloor was for protection purposes.

Prior to laying the Sempafloor the bare concrete floor failed to meet The Building Standards (Scotland) Amendment Regulations 1987 requirement of $L'_{nT,w}$ value of 61 dB.

After the Sempafloor has been laid the requirements are easily met, with a value of 50 dB.

Leith Walk Development

In this particular project, which is the construction of a new block of flats, the timber floating floor over the new concrete floor was tested for impact sound. The results were, in fact, very good and easily meets the regulations. Does putting a layer of Sempafloor on the surface of the floating floor improve the impact sound insulation?

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Material Description	L'_{nTw}
a. Timber floating floor (LR/LR) on resilient lyr	55
b. Sempafloor on floating floor (LR/LR) on ditto	53
c. Timber floating floor (LR/LR) on resilient lyr	54
d. Sempafloor on floating floor (LR/LR) on ditto	53

Figure 23: Comparison of the impact sound insulation of the above four sets of results showing the difference in the insulation value of the floating layer floor after Sempafloor has been laid. Since the floating layer is already laid on a layer of resilience, e.g. fibreglass quilt, any further resilience proves to be of little improvement. Obviously, this floor construction meets the regulation requirements.

Prior to laying the Sempafloor the timber floating floor meets The Building Standards (Scotland) Amendment Regulations 1987 requirements of $L'_{nT,w}$ value of 61 dB.

Timber Floors

Danube Street

Partitioning an existing tenement block into flats. Impact sound insulation tests carried out on an existing timber separating floor.

Material Description	L'_{nTw}
a. Bare timber floor (Living Room/Living Room)	63
b. Sempafloor layer only on above floor (LR/LR)	57
c. Bare timber floor (Bedroom/Bedroom)	67
d. Sempafloor layer only on the above floor (Bd/Bd)	54

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Figure 24: Comparison of the impact sound insulation of the above four results showing the difference in the insulation value of the bare timber floor after Sempafloor has been laid.

Prior to laying the Sempafloor the bare timber floors fail to meet The Building Standards (Scotland) Amendment Regulations 1987 requirement of $L'_{nT,w}$ value of 61 dB.

After the Sempafloor has been laid the requirements are easily met.

Grange

Partitioning an existing town house into two flats. Impact sound insulation tests carried out on the existing timber separating floor

Material Description		L'_{nTw}
a.	Bare timber floor (Dining Room/Living Room)	68
b.	Sempafloor layer only on above floor (DR/LR)	61
c.	Plywood on Sempafloor on the above floor (DR/LR)	59

Figure 25: Comparison of the impact sound insulation of the above test result showing the difference in the insulation value of the bare timber floor after Sempafloor has been laid. In this instance a layer of plywood was laid over the Sempafloor for protection purposes and retested. The results show a further improvement in the impact sound insulation value.

Prior to laying the Sempafloor the bare timber floors fail to meet The Building Standards (Scotland) Amendment Regulations 1987 requirement of $L'_{nT,w}$ value of 61 dB.

Because of the very high initial failure, the laying of the Sempafloor just meets the requirements.

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Morningside Place

Partitioning an existing town house into two flats. Impact sound insulation tests carried out on the existing timber separating floor.

Material Description	L'_{nTw}
a. Bare timber floor (Kitchen/Living Room)	62
b. Plywood on Sempafloor on the above floor (Kt/LR)	55

Figure 26: Comparison of the impact sound insulation of the above test result showing the difference in the insulation value of the bare timber floor after Sempafloor has been laid. In this instance a layer of plywood was laid over the Sempafloor for protection purposes and retested. The results show a further improvement in the impact sound insulation value.

Prior to laying the Sempafloor the bare timber floors fail to meet The Building Standards (Scotland) Amendment Regulations 1987 requirement of $L'_{nT,w}$ value of 62 dB.

The laying of the plywood over the Sempafloor improves the impact sound insulation resulting in a satisfactory floor test. Again the plywood was laid for protection of the Sempafloor resilient layer.

St. Patrick's Square

Partitioning an existing tenement into flats. Impact sound insulation tests carried out on the existing timber separating floor. Again, initially the floors failed to meet the impact sound insulation regulation requirements. However after a layer of plywood was laid over a layer of Sempafloor, the floors were retested and successfully met the requirements.

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Material Description	L'_{nTw}
a. Bare timber floor (Bedroom/Kitchen)	66
b. Plywood on Sempafloor on the above floor (Bd/Kt)	57
c. Bare timber floor (Kitchen/Kitchen)	66
d. Plywood on Sempafloor on the above floor (Kt/Kt)	57

Figure 27: Comparison of the impact sound insulation of the above test results showing the difference in the impact sound insulation value of the bare timber floor in two areas after Sempafloor has been laid. In this instance a layer of plywood was laid over the Sempafloor for protection purposes and retested. The results show a further improvement in the impact sound insulation value.

Prior to laying the Sempafloor the bare timber floors fail to meet The Building Standards (Scotland) Amendment Regulations 1987 requirement of $L'_{nT,w}$ value of 66 dB.

Vietnamese Restaurant

Here there was a noise problem created by a Restaurant on the ground floor with a private flat in the Basement. The occupier of the flat continually complained of the problem of footstep noise etc. on the existing timber separating floor. The kitchen equipment was removed and a layer of Sempafloor was laid which was then covered with a layer of plywood for protection. Other pieces of Sempafloor were actually placed under noise sensitive areas as anti-vibration mounts.

Material Description	L'_{nTw}
a. Bare timber floor (Kitchen/Bedroom	68
b. Plywood on Sempafloor on the above floor (Kt/Bd)	58

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Figure 28: Comparison of the impact sound insulation of the above test result showing the difference in the insulation value of the bare timber floor after Sempafloor has been laid. In this instance a layer of plywood was laid over the Sempafloor for protection purposes and retested. The results show a large improvement in the impact sound insulation value. No further complaints were received from the occupier of the flat.

Prior to laying the Sempafloor the bare timber floors fail to meet The Building Standards (Scotland) Amendment Regulations 1987 requirement of $L'_{nT,w}$ value of 68 dB.

In this instance the initial failure was very high, at 68 dB, however the plywood and the Sempafloor succeeded in improving the impact sound insulation of the floor to an acceptable level.

I trust that you will find this Report of use, however should you require any further information please do not hesitate to contact me at any time.

David J. MacKenzie BSc., MSc., MIOA.
Department of Building.

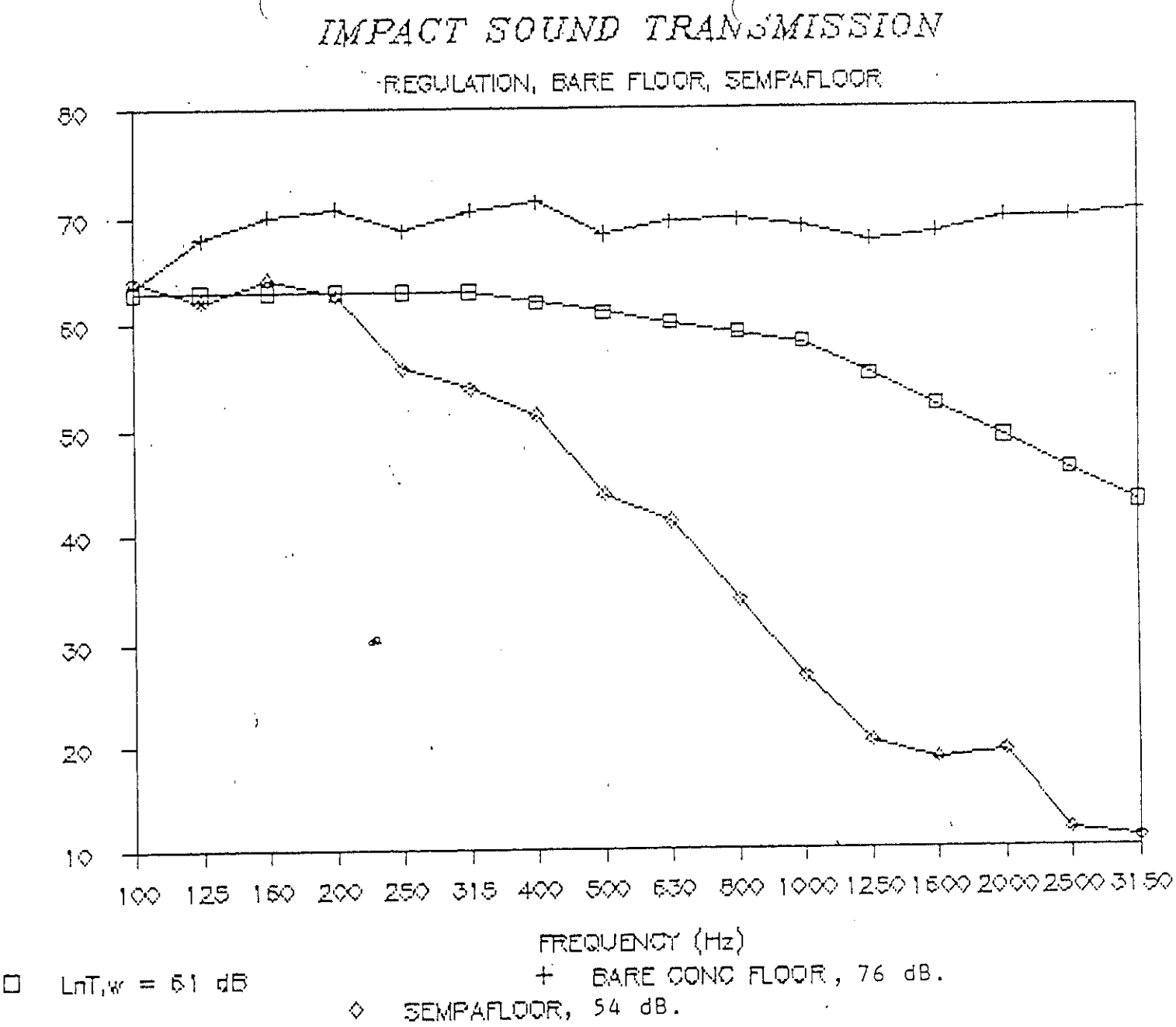

Figure 1: Impact Sound Insulation: Bare Concrete and Sempafloor

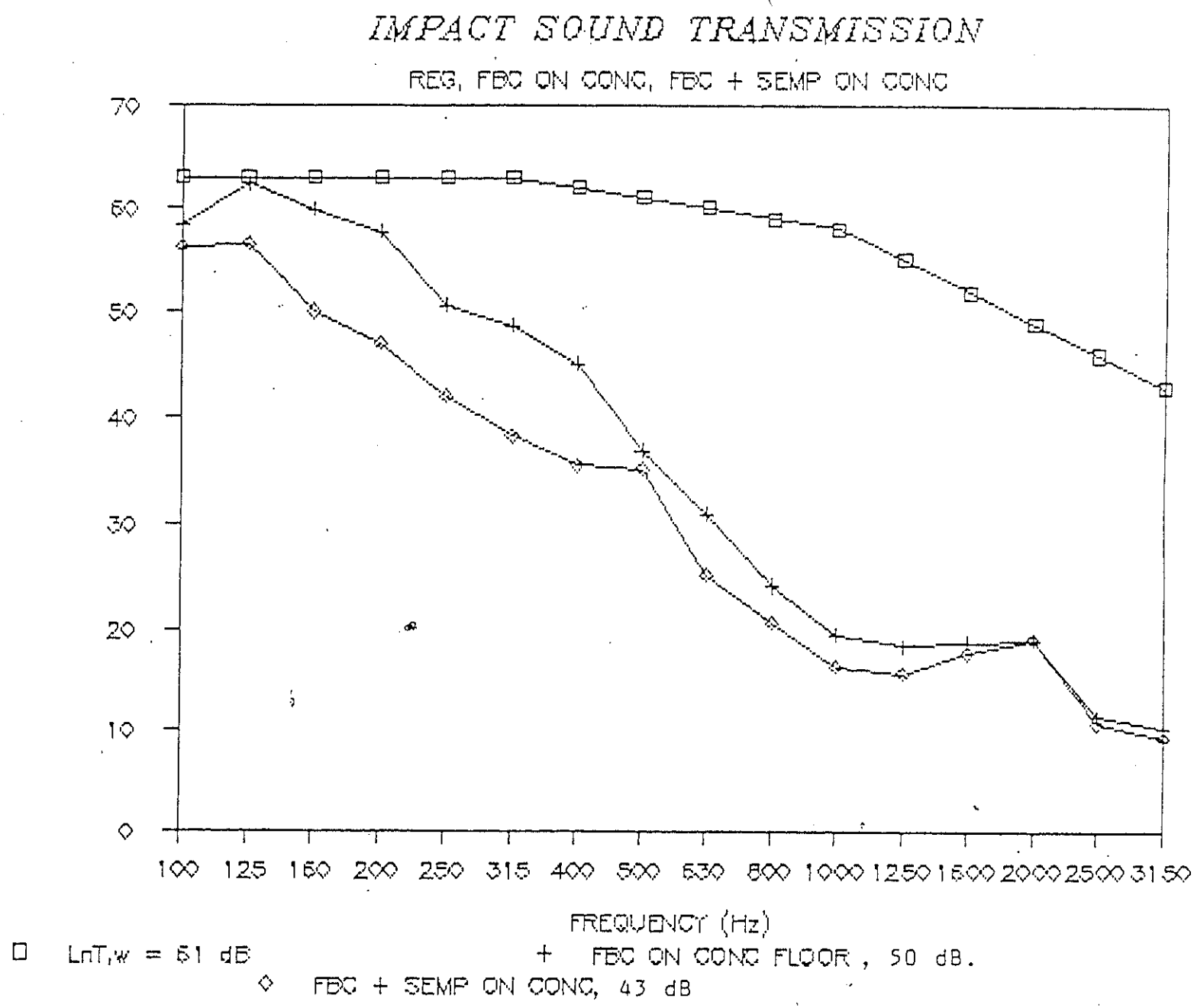

Figure 2: Impact Sound Insulation: Foam Backed Carpet & Sempafloor

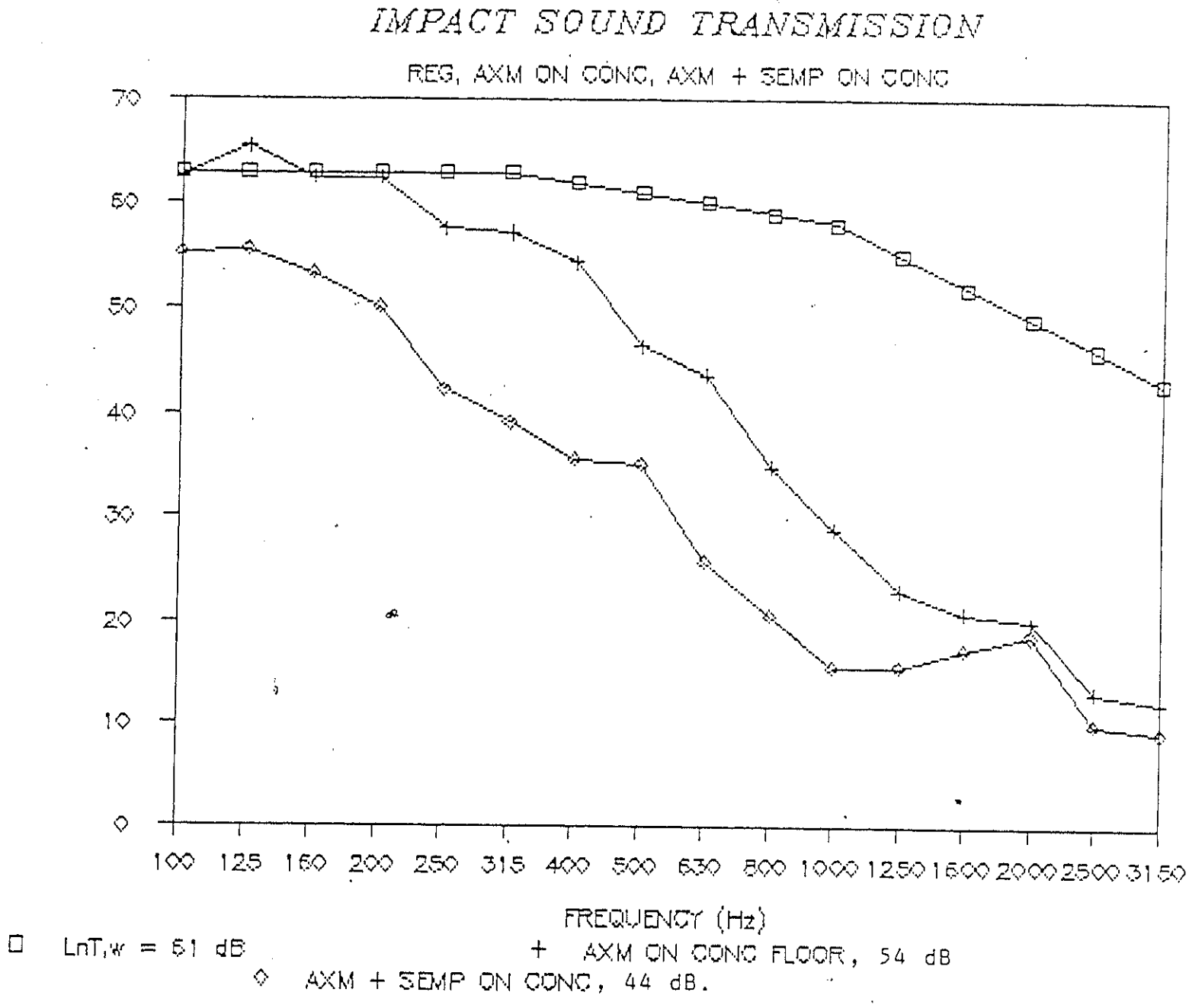

Figure 3: Impact Sound Insulation: Axminster Carpet & Sempafloor

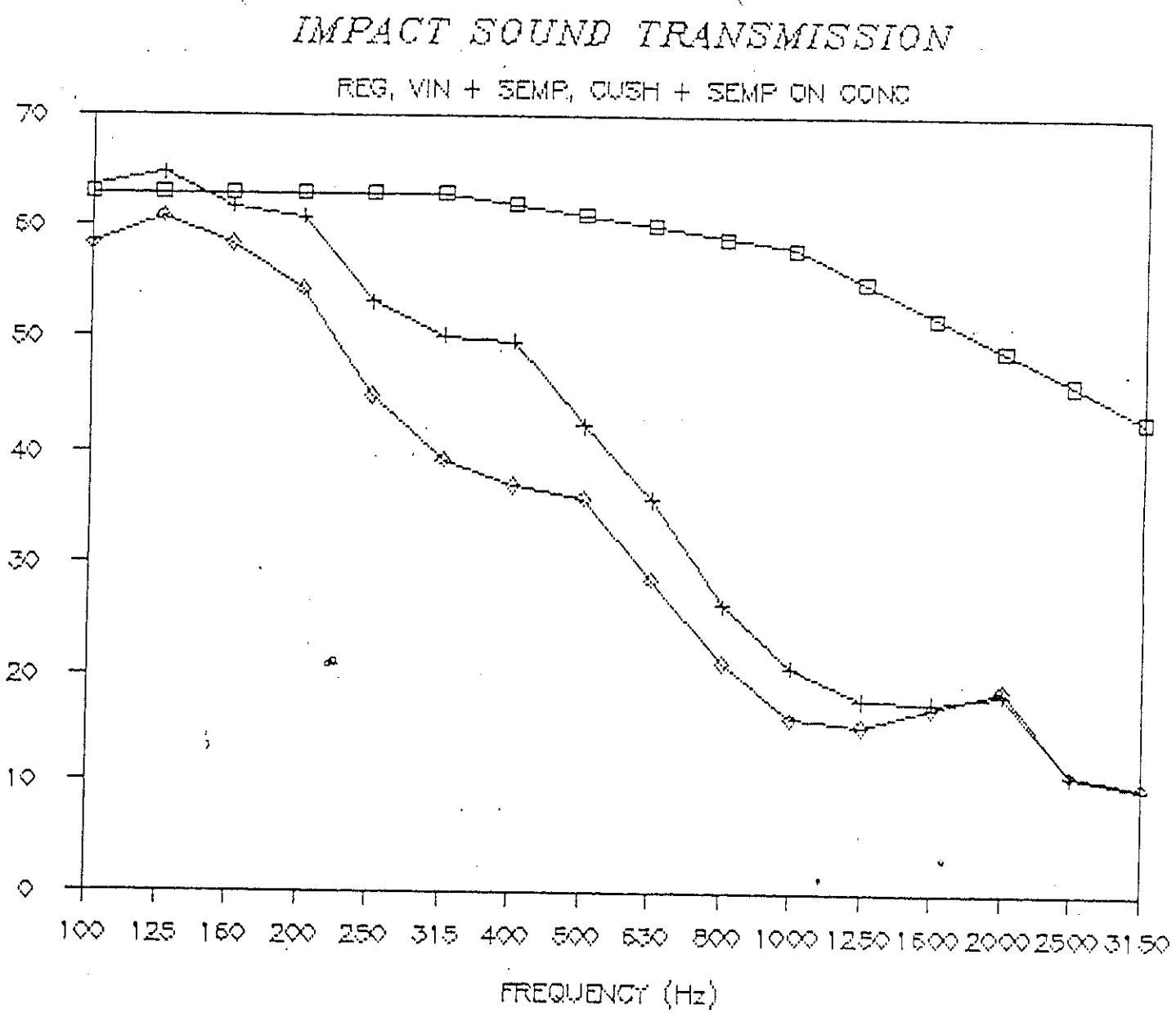

Figure 5: Impact Sound insulation: Vinyl & Cushionfloor & Sempaf floor

IMPACT SOUND TRANSMISSION

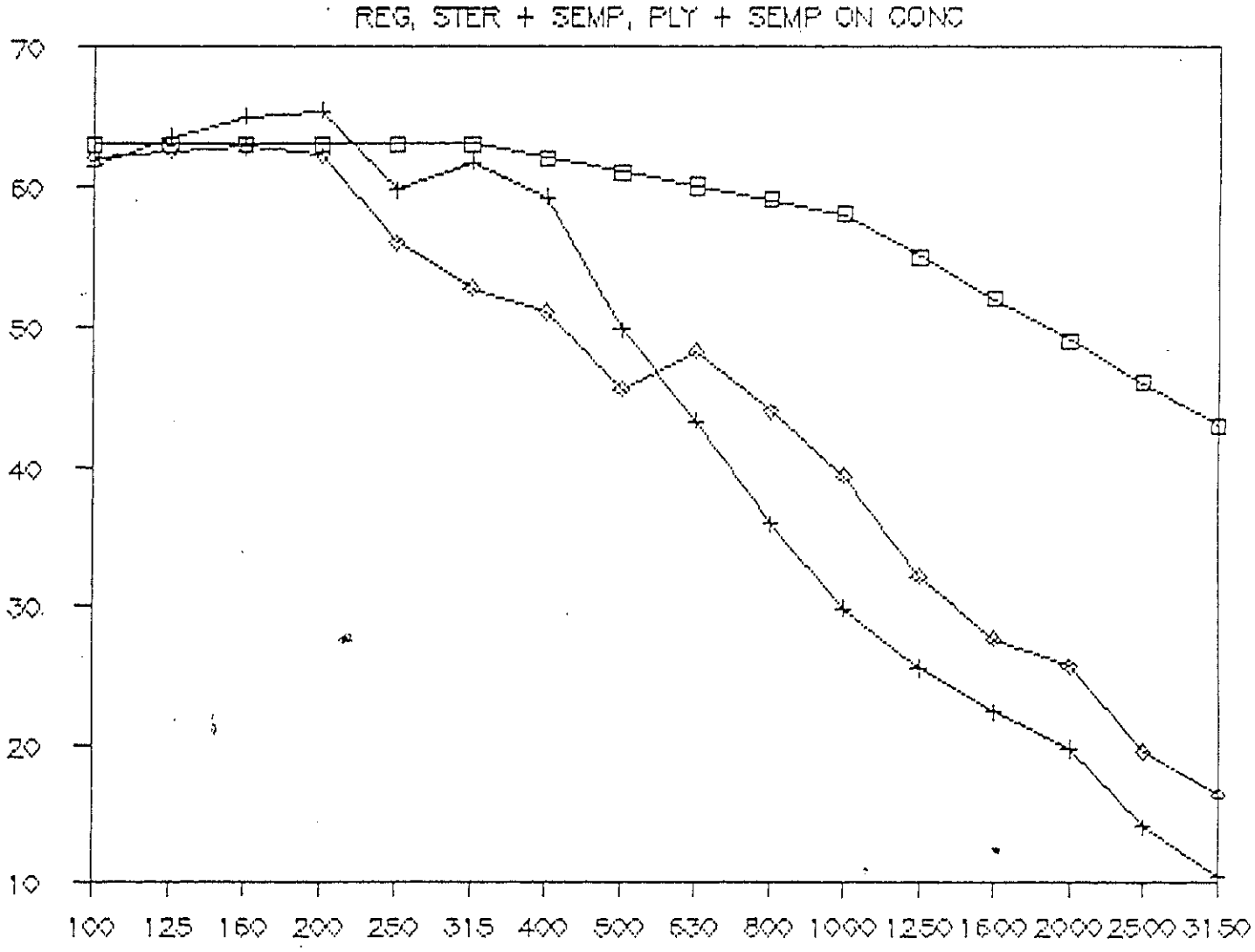

Figure 6: Impact sound Insulation: Sterling & Plywood on Sempfloor

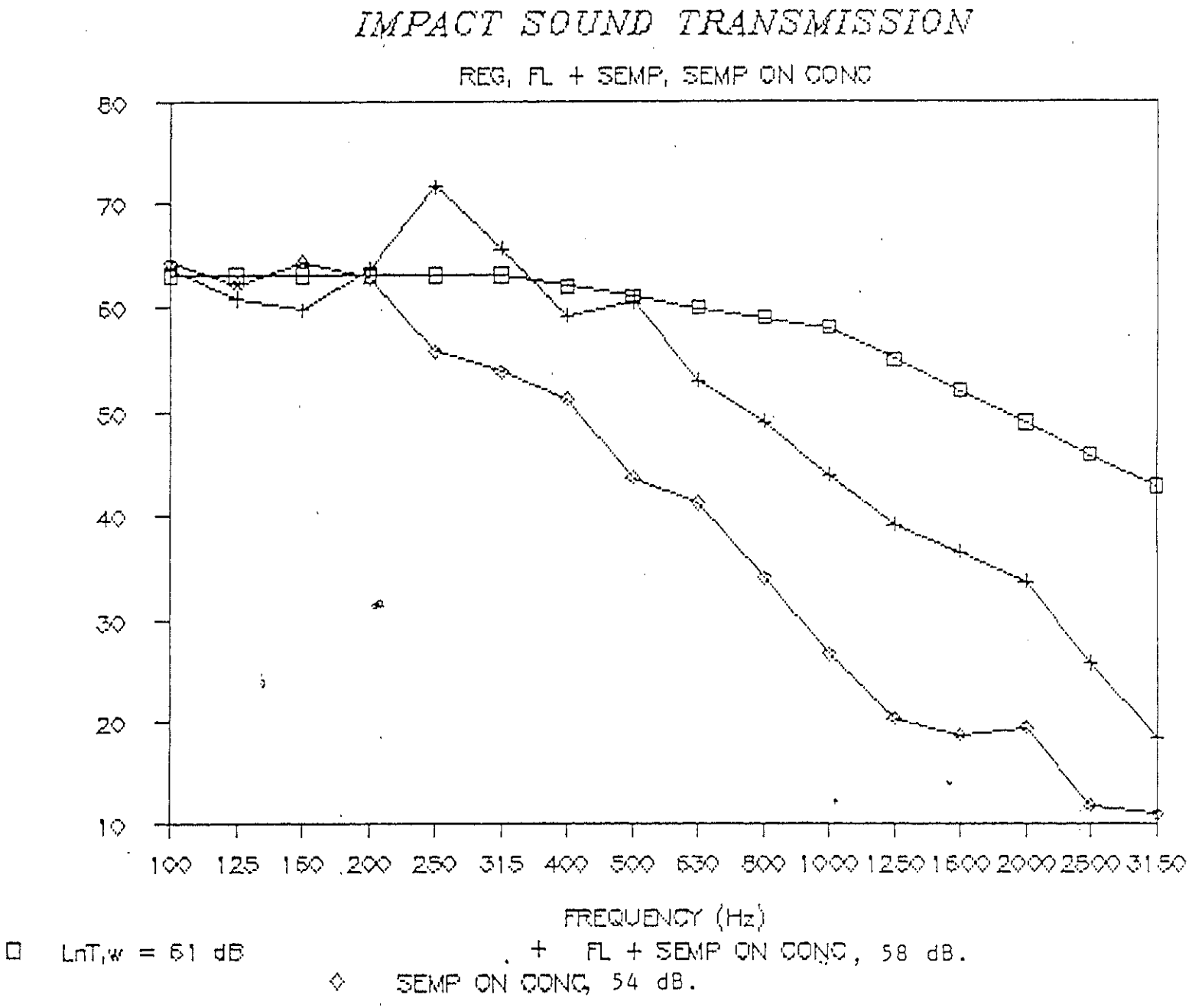

Figure 7: Impact Sound Insulation: Floating Layer & Sempafloor

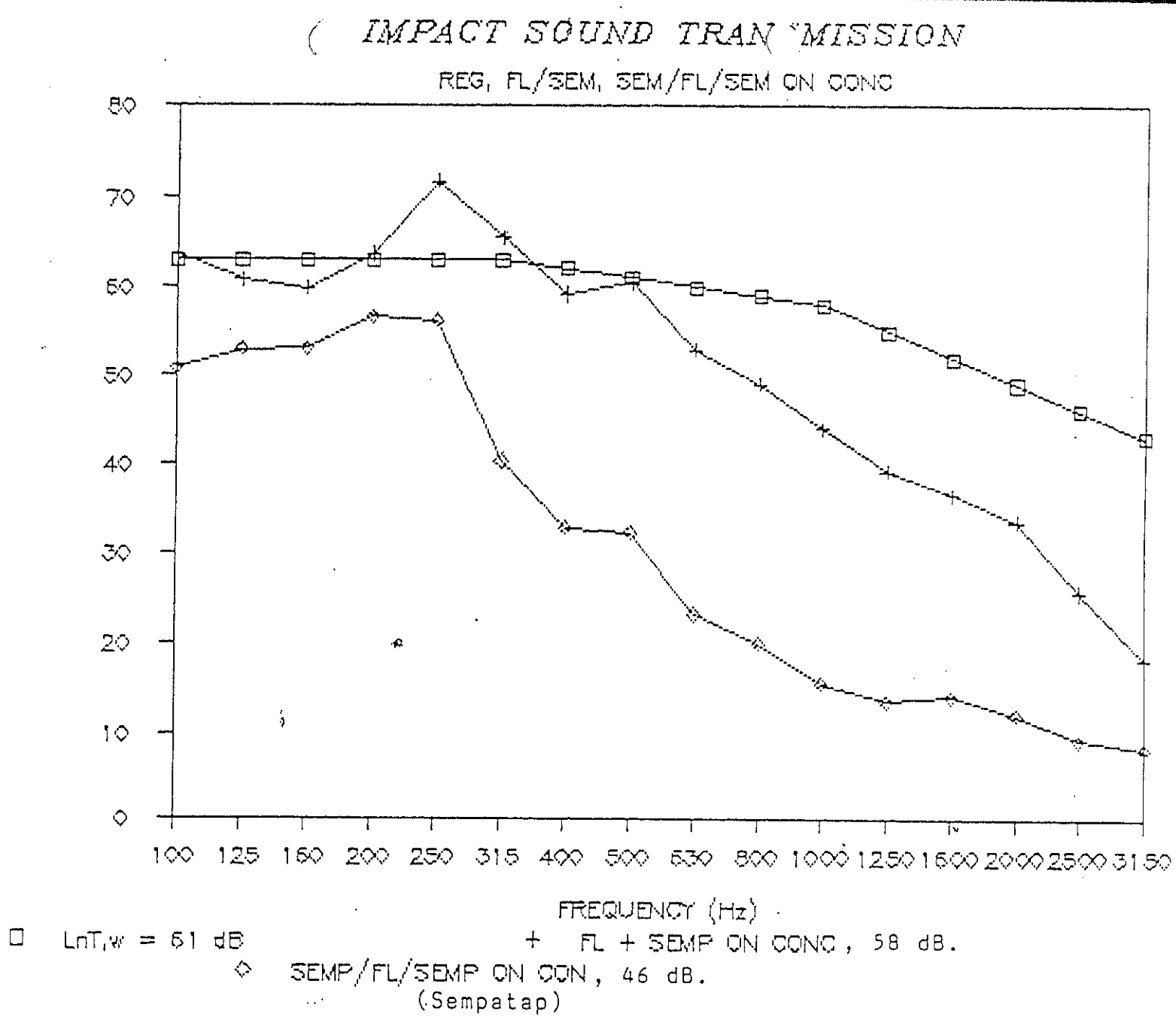

Figure 8: Impact Sound Insulation: Sempafloor & Floating Layer & Sempatap.

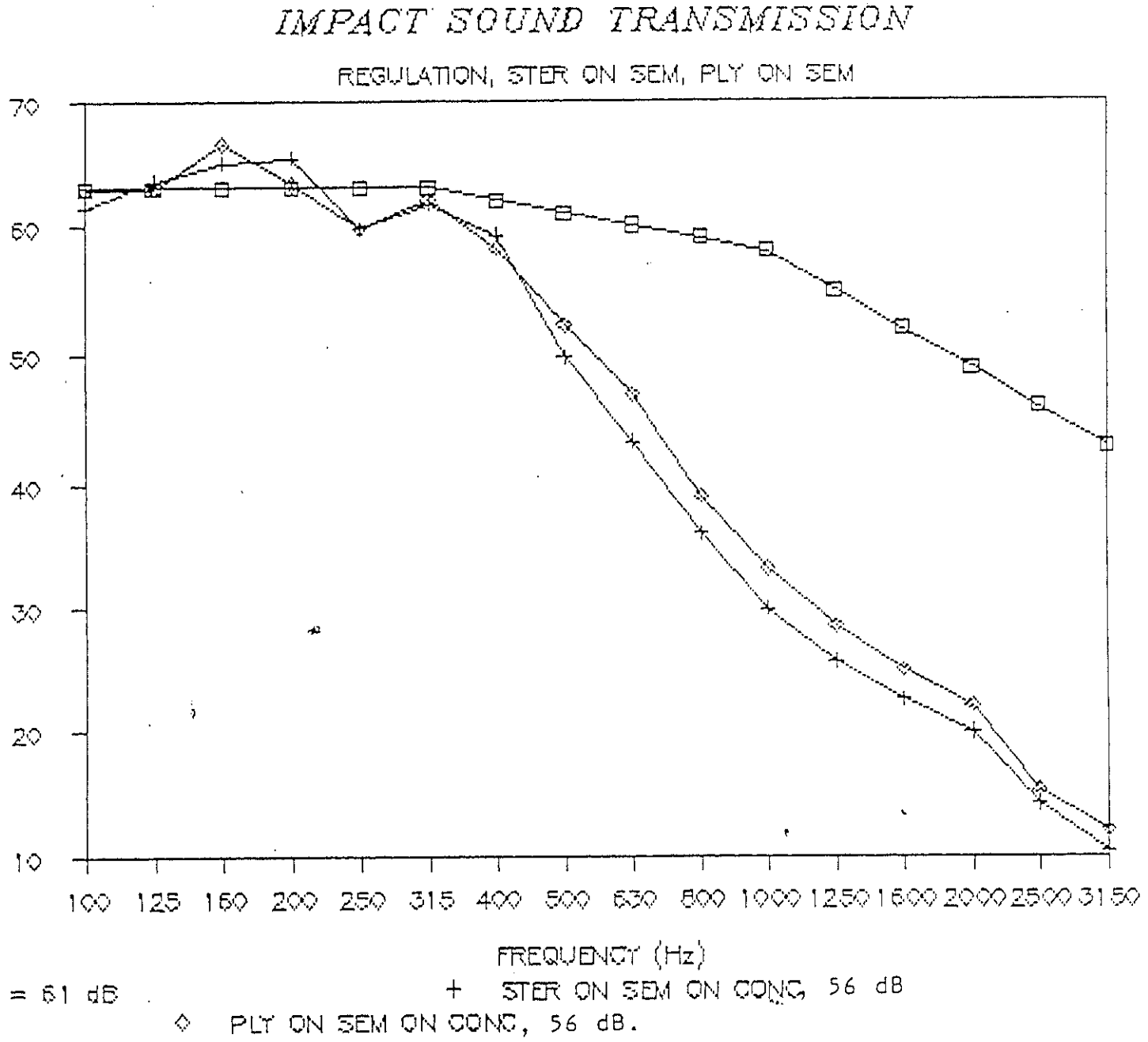

Figure 9: Impact Sound Insulation: Sterling & Plywood on Sempafloor (Timber floor)

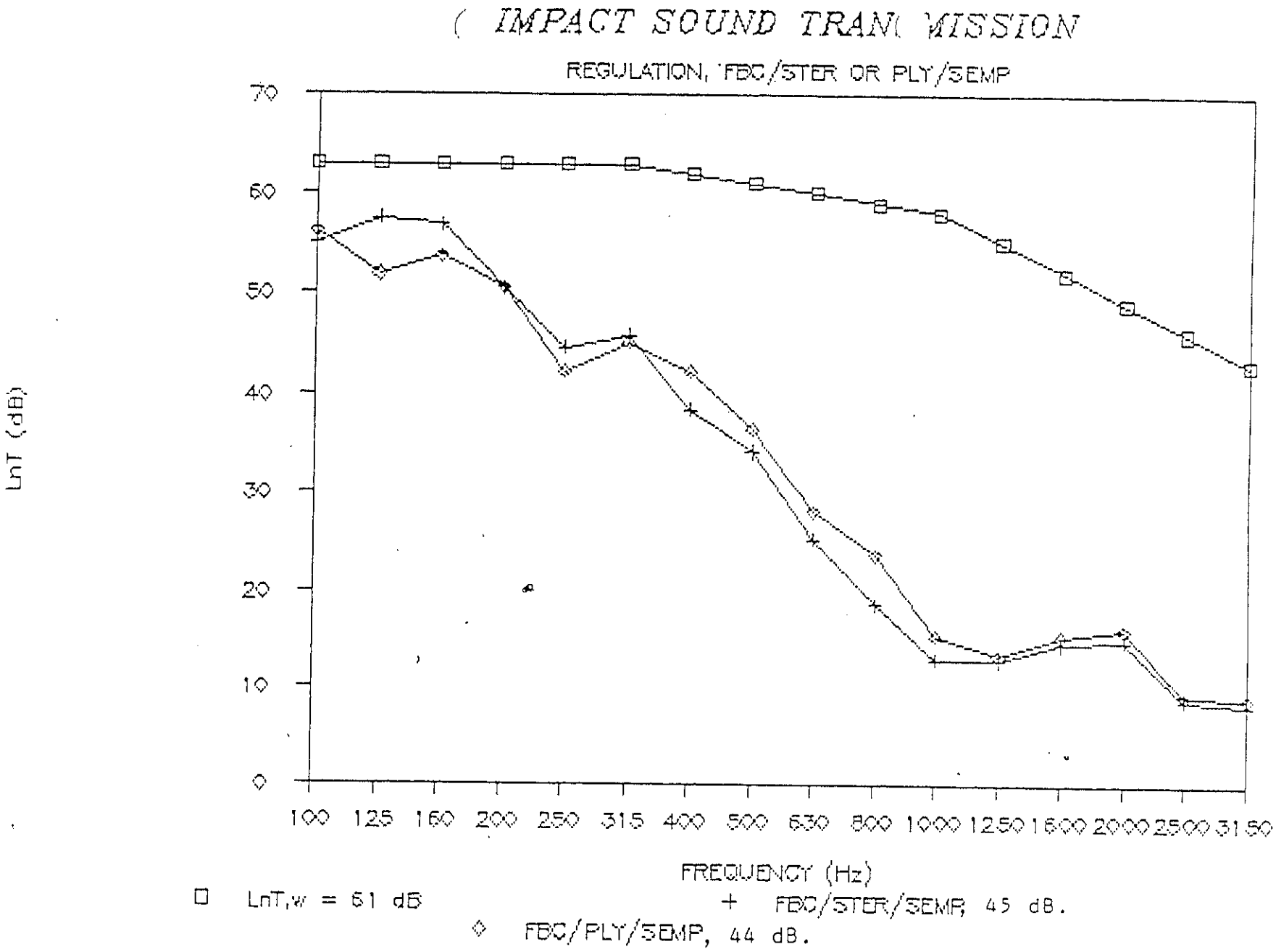

Figure 10: Impact Sound insulation: Foam Backed Carpet and Sempafloor (Timber floor)

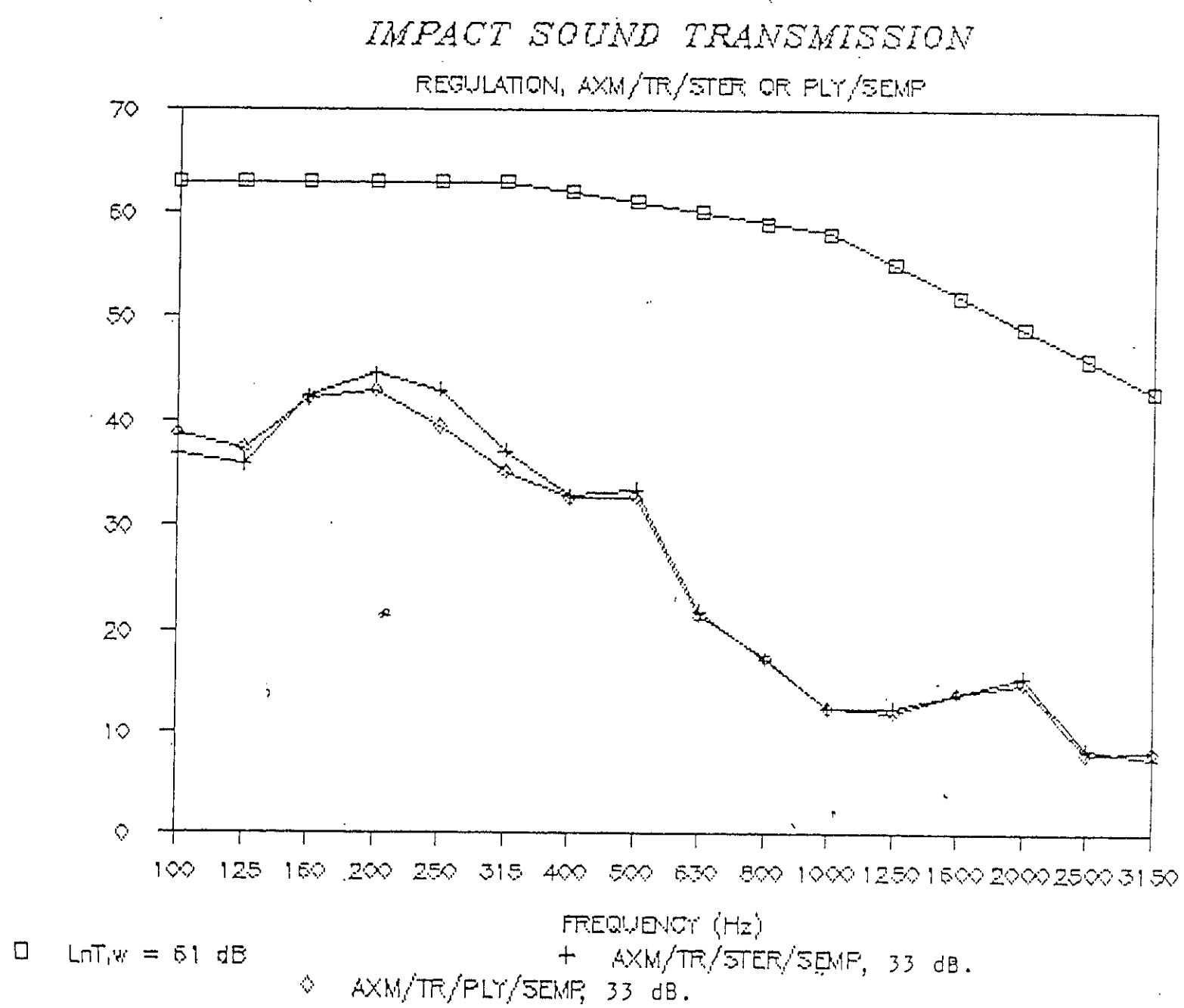

Figure 11: Impact Sound Insulation: Axminster, Treadair and Sterling on Plywood (Timber floor)

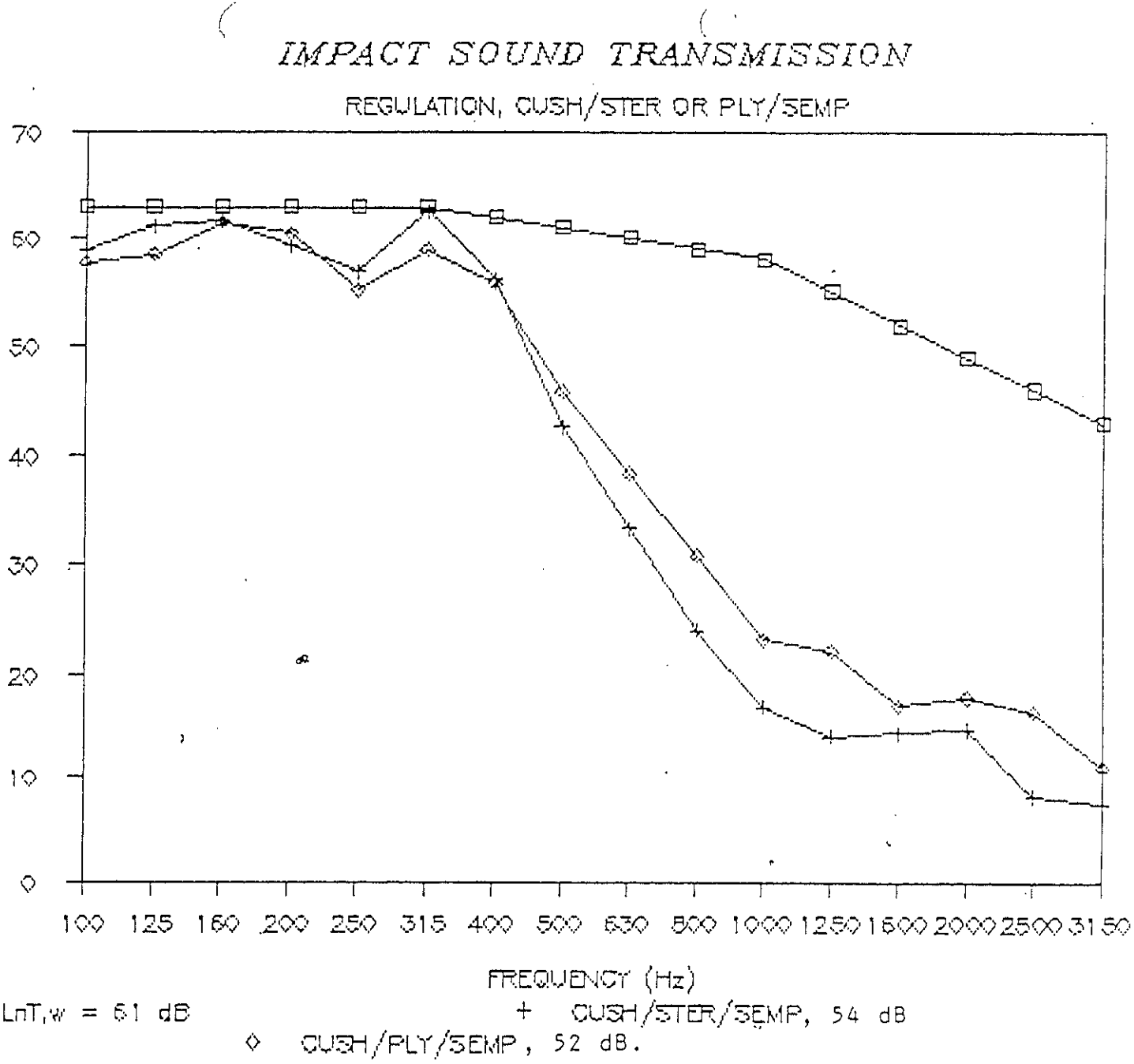

Figure 12: Impact Sound Insulation: Cushionfloor on Plywood or Sterling and Sempafloor (Timber Floor)

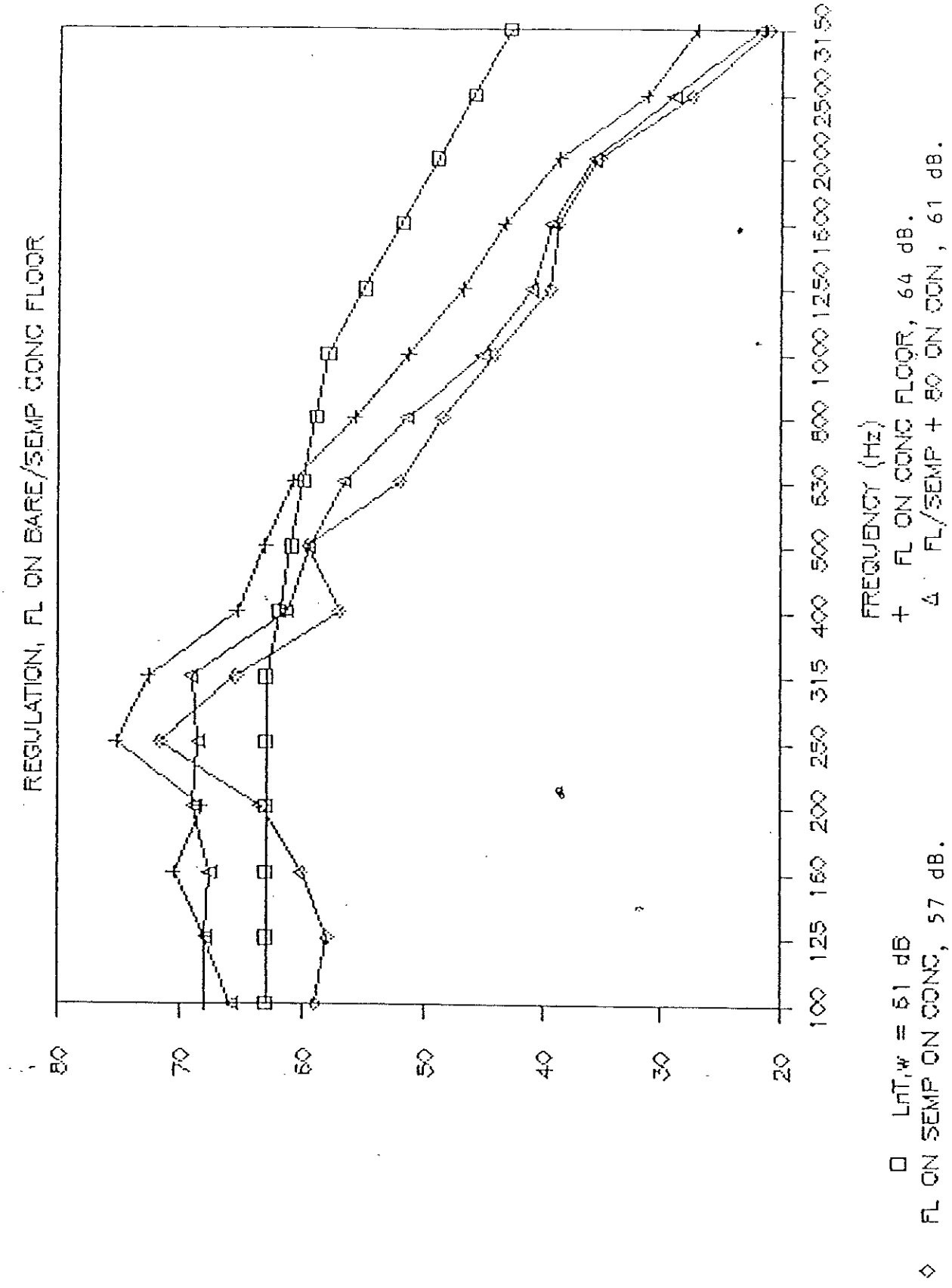

Figure 13: Impact Sound Insulation: Floating Timber Floor, on Sempafloor.

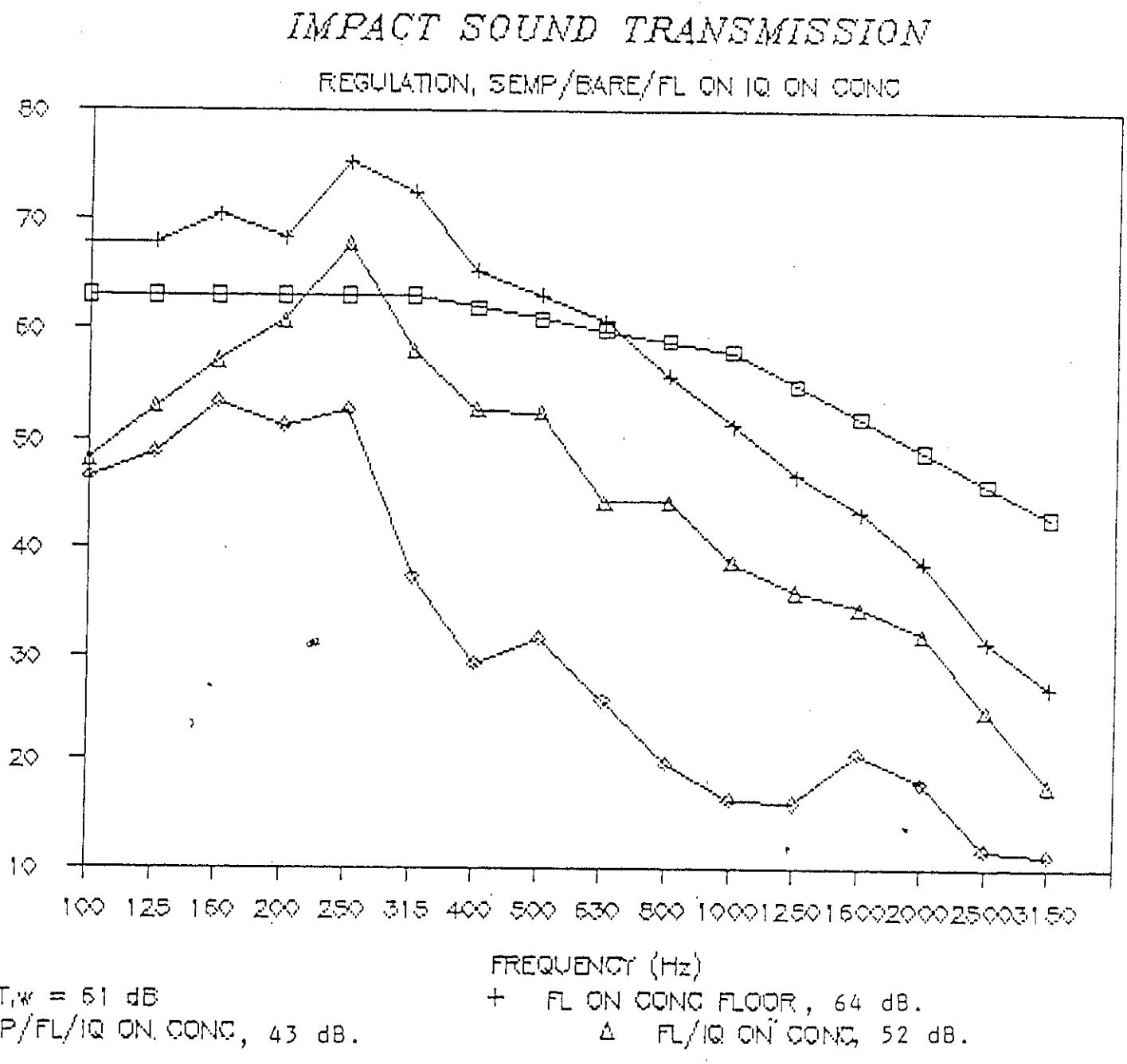

Figure 15: Impact Sound Insulation: Floating Timber Floor on Insulation Quilt.

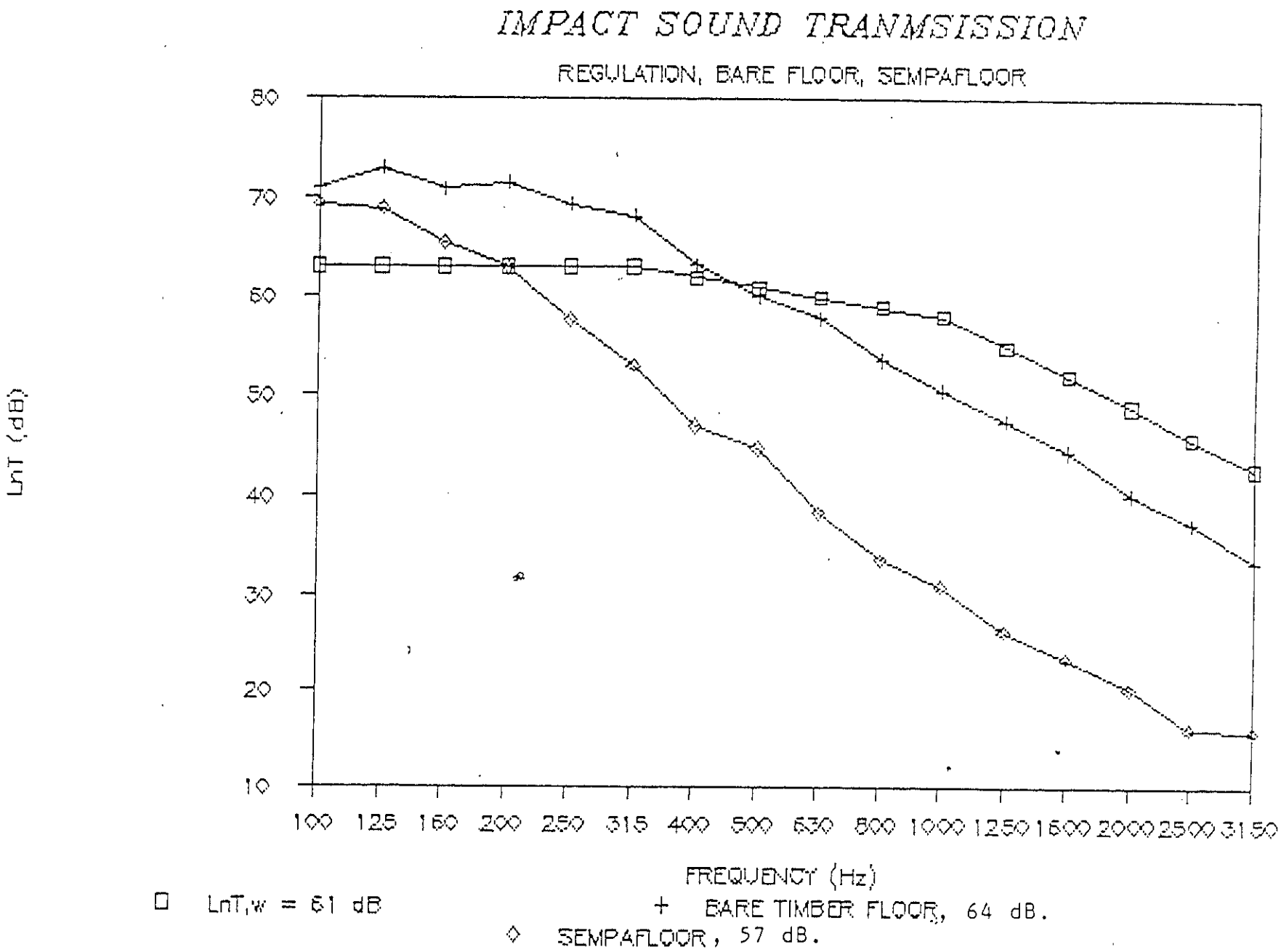

Figure 15: Impact Sound insulation: Timber floor & Sempafloor

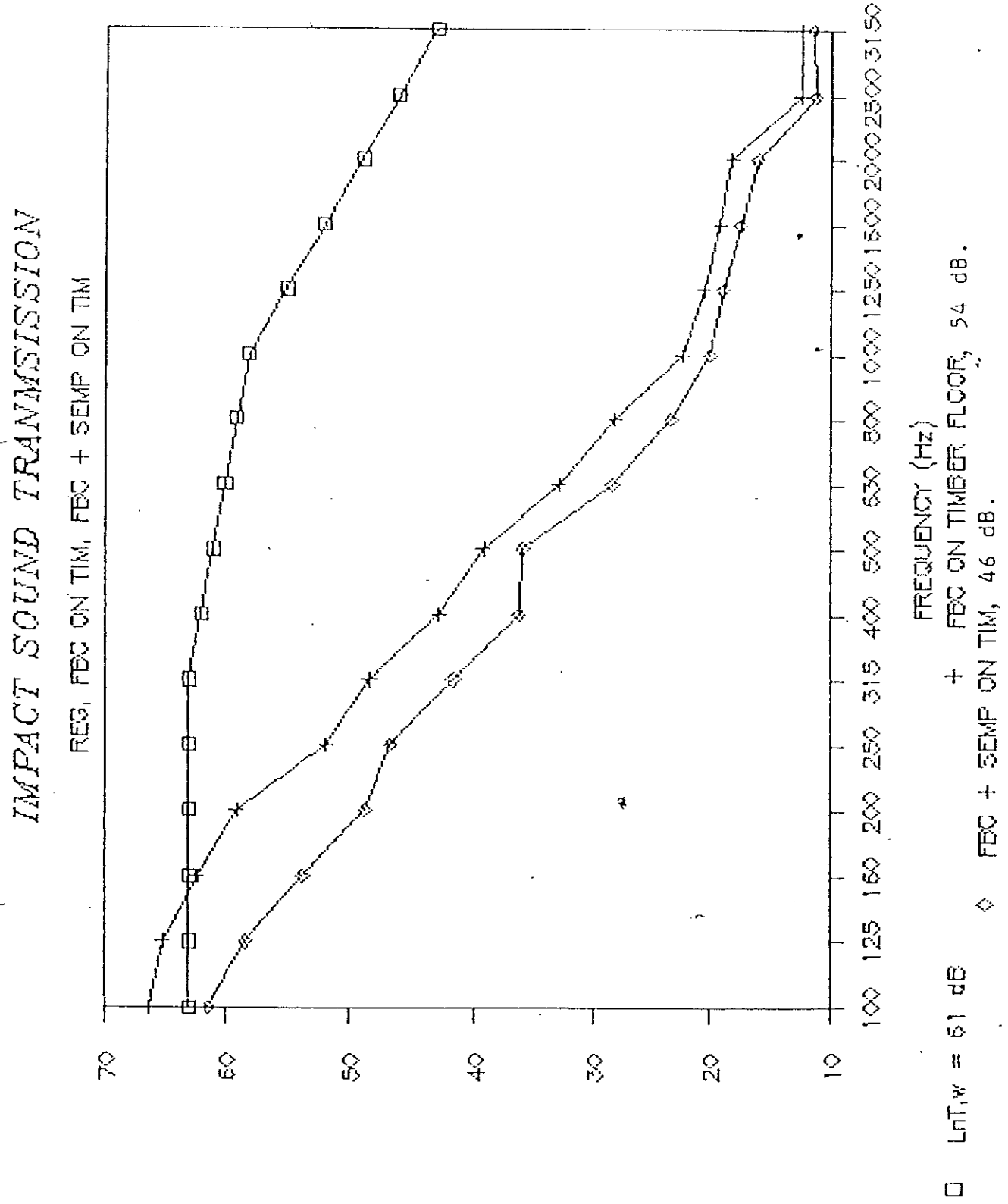

Figure 16: Impact Sound Insulation: Foam Backed Carpet & Sempafloor.

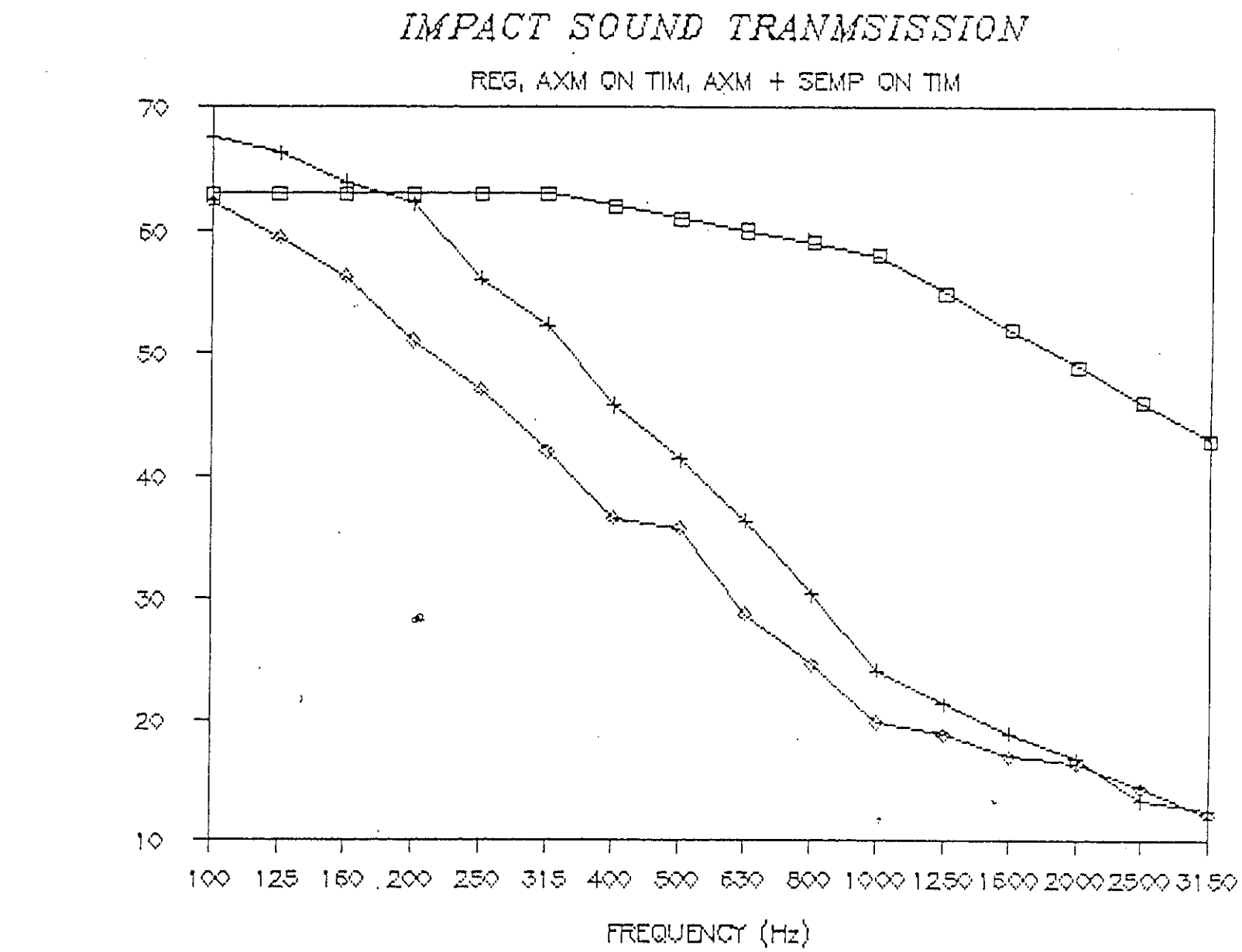

Figure 17: Impact Sound Insulation: Axminster Carpet & Sempafloor.

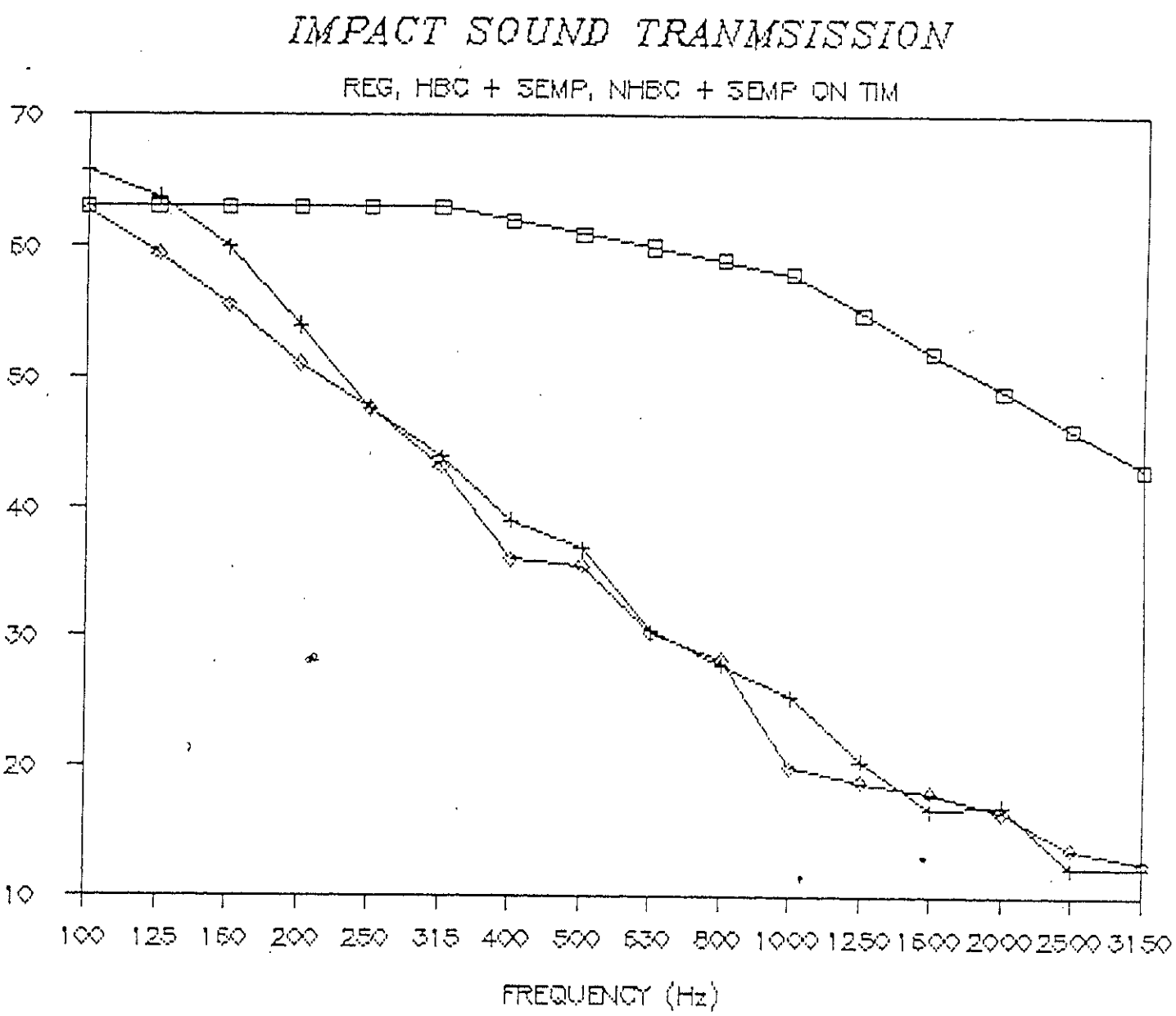

Figure 18: Impact Sound Insulation: Nylon Carpet and Hard Backed Carpet and Sempafloor

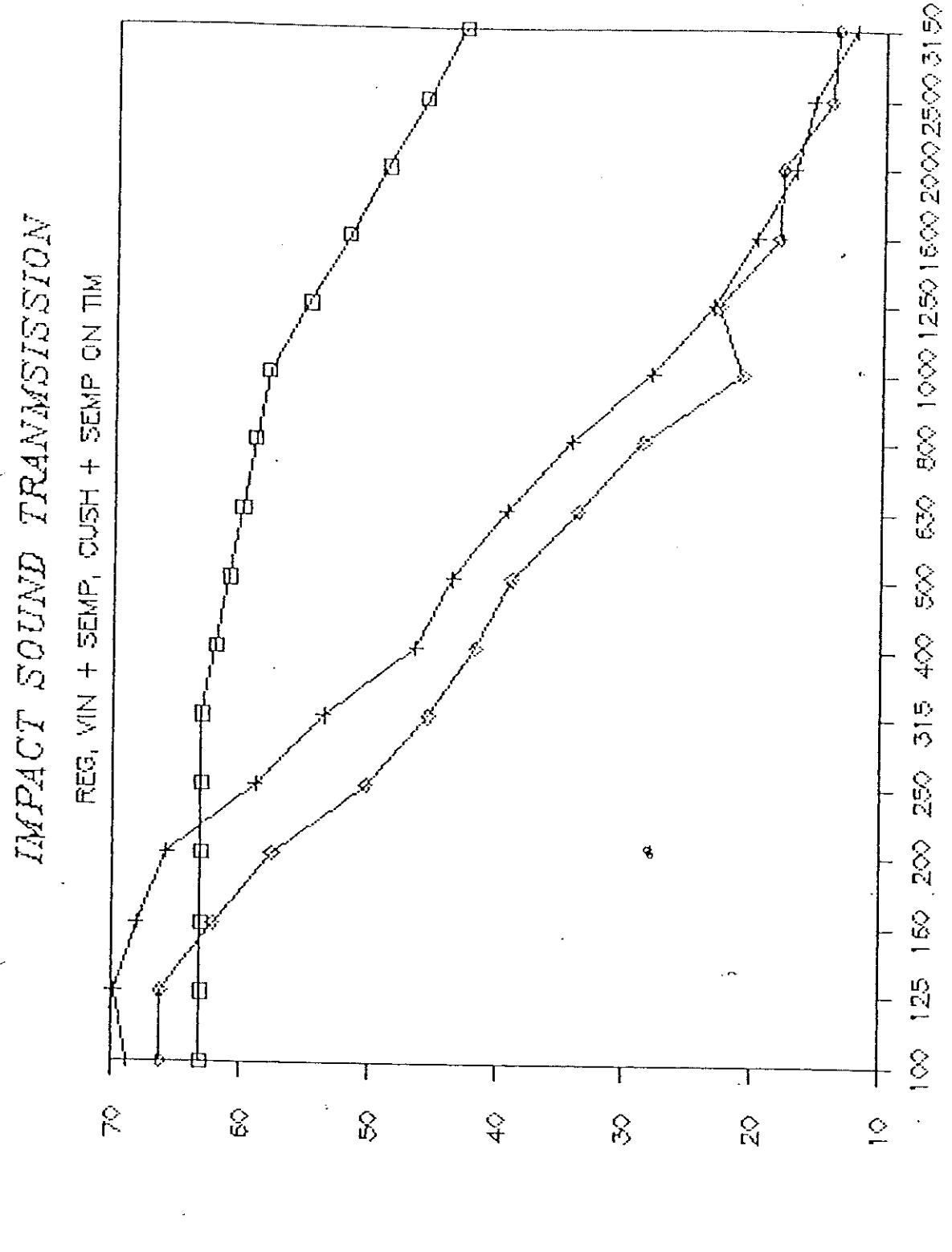

Figure 19: Impact Sound Insulation: Vinyl and Cushionfloor and Sempafloor.

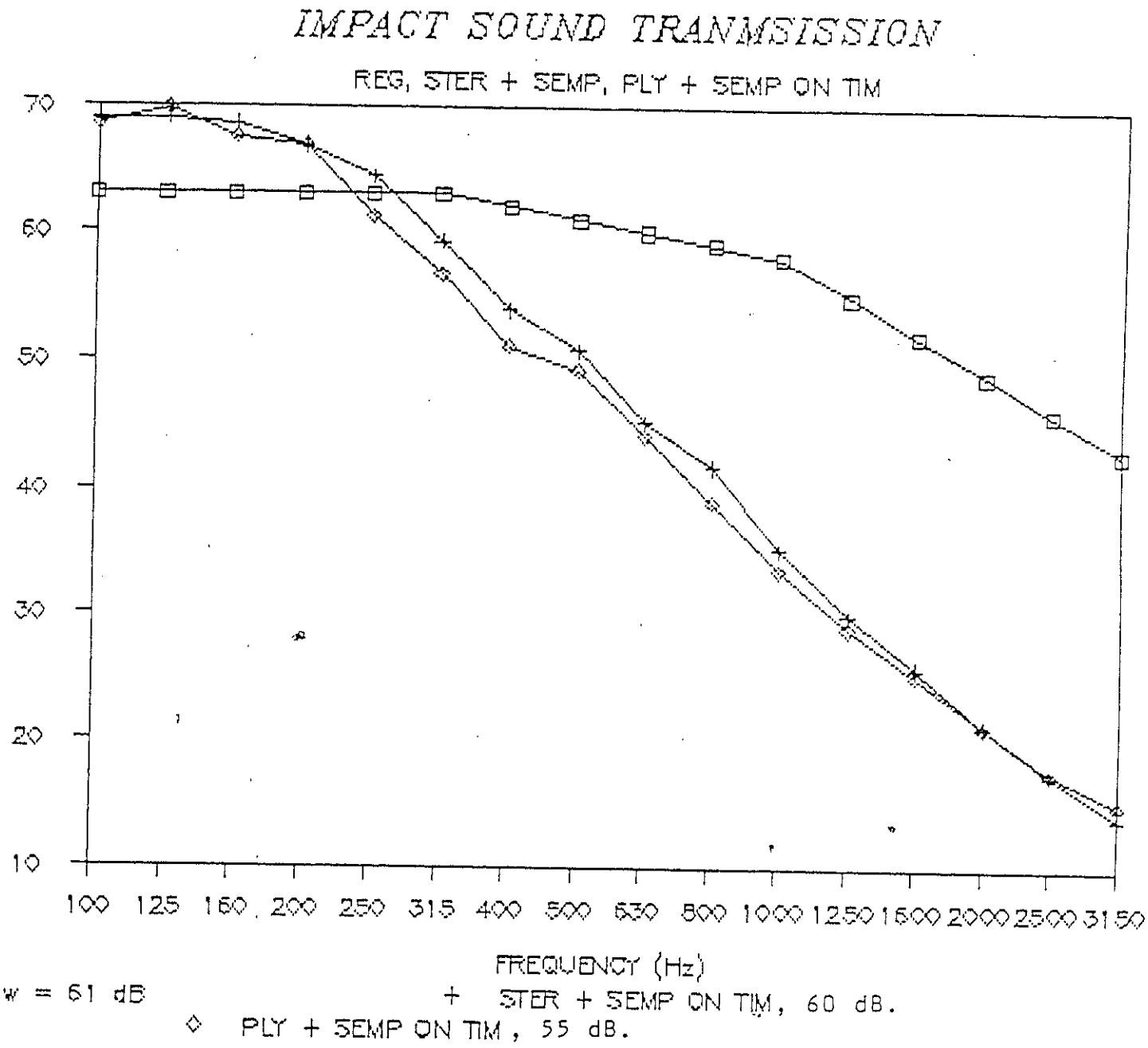

Figure 20: Impact Sound Insulation: Sterling and plywood and Sempafloor.

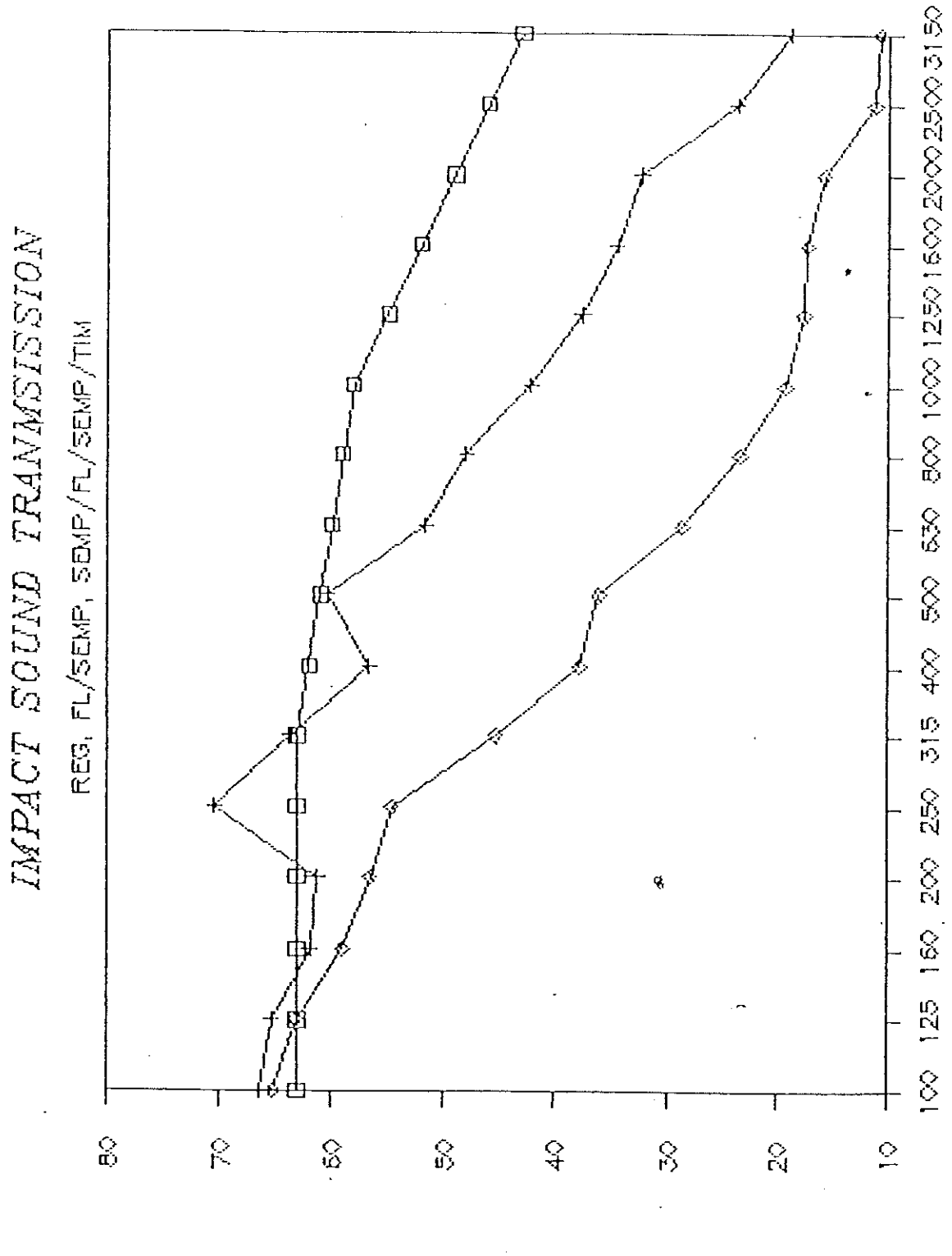

Figure 21: Impact Sound Insulation: Floating Timber Layer and Sempafloor.

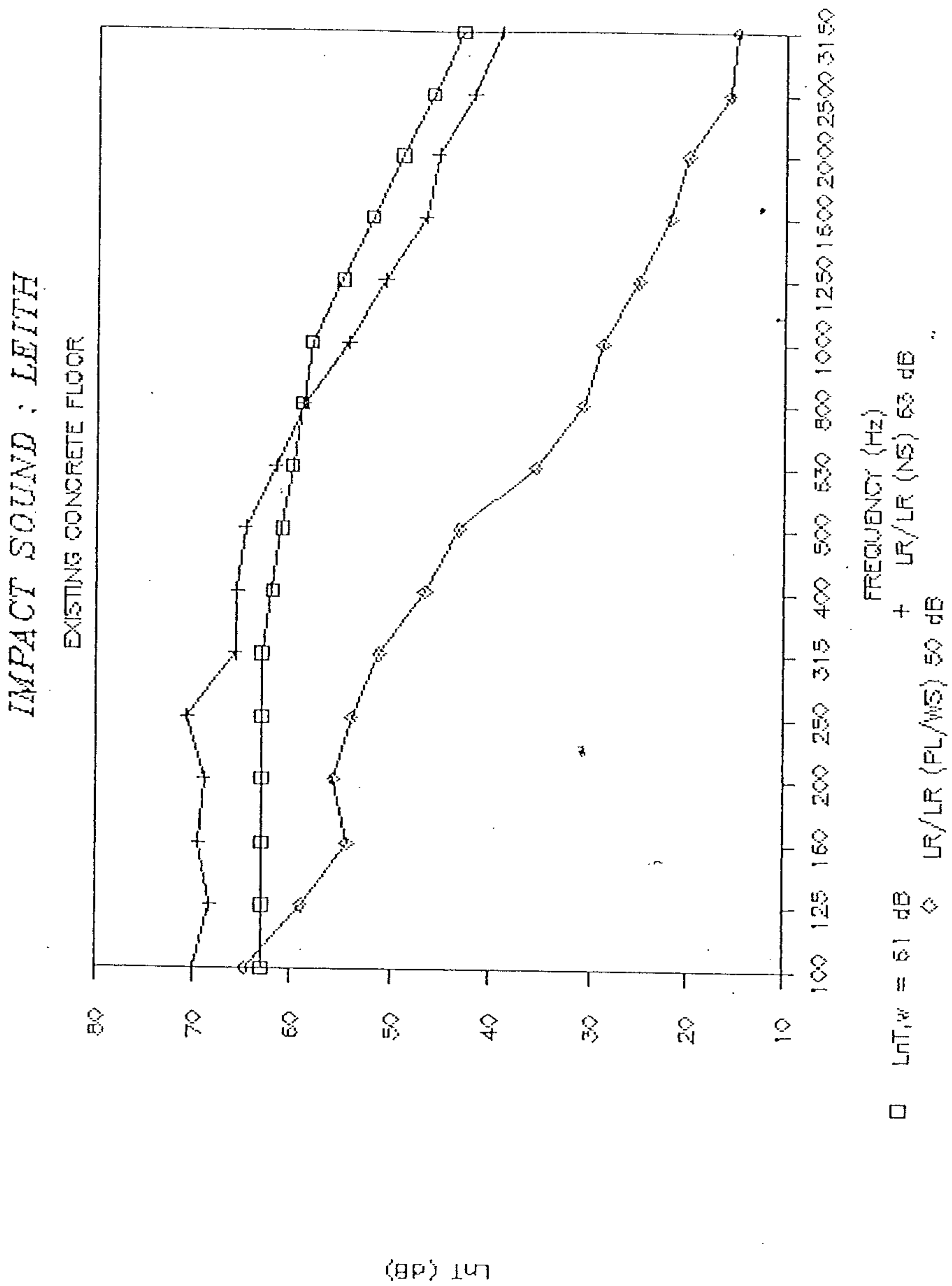

Figure 22: Impact Sound Insulation: Separating Floor: Leith

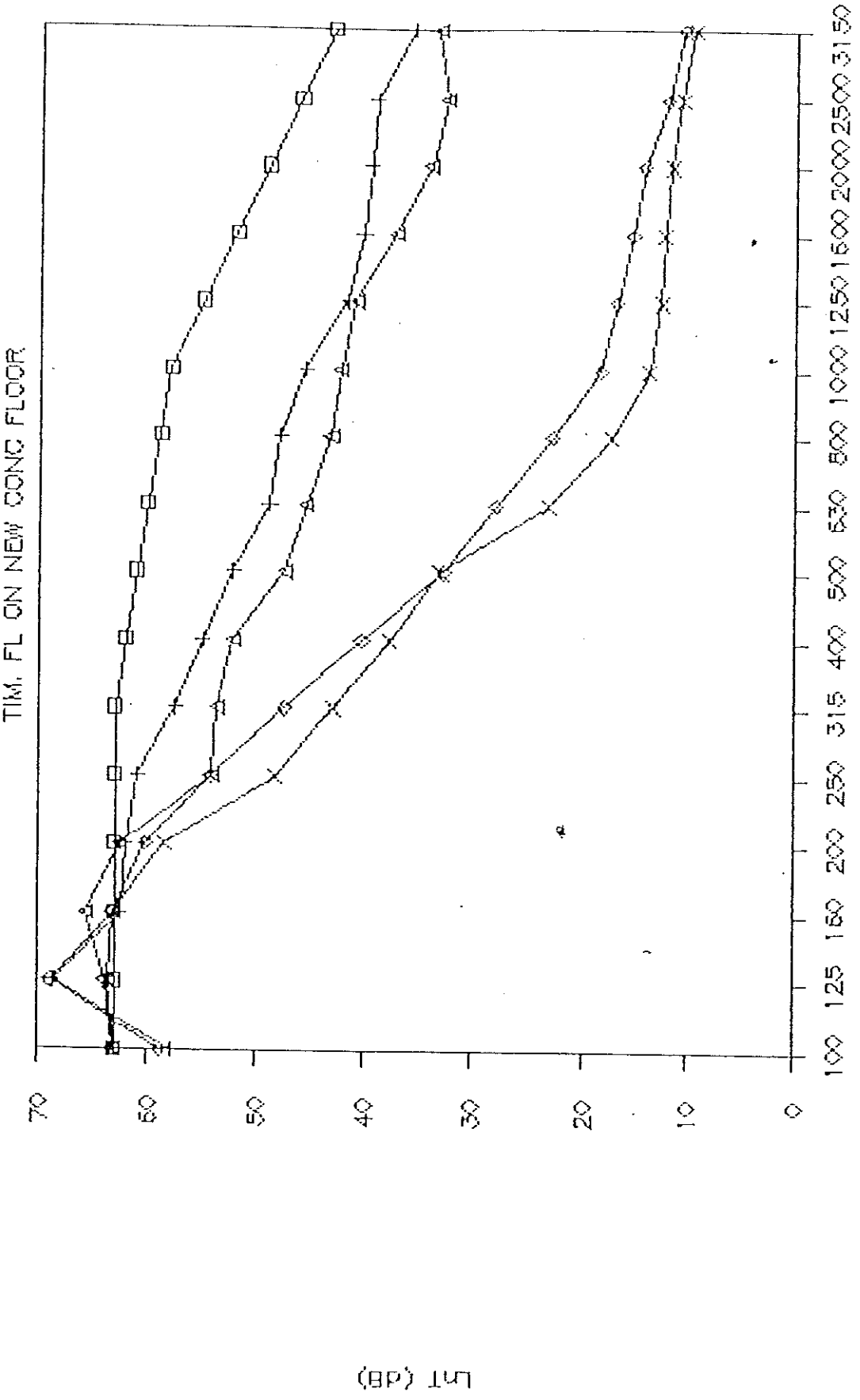

Figure 23: Impact Sound Insulation: Separating Floor: Leith Walk Development.

IMPACT SOUND : DANUBE STREET

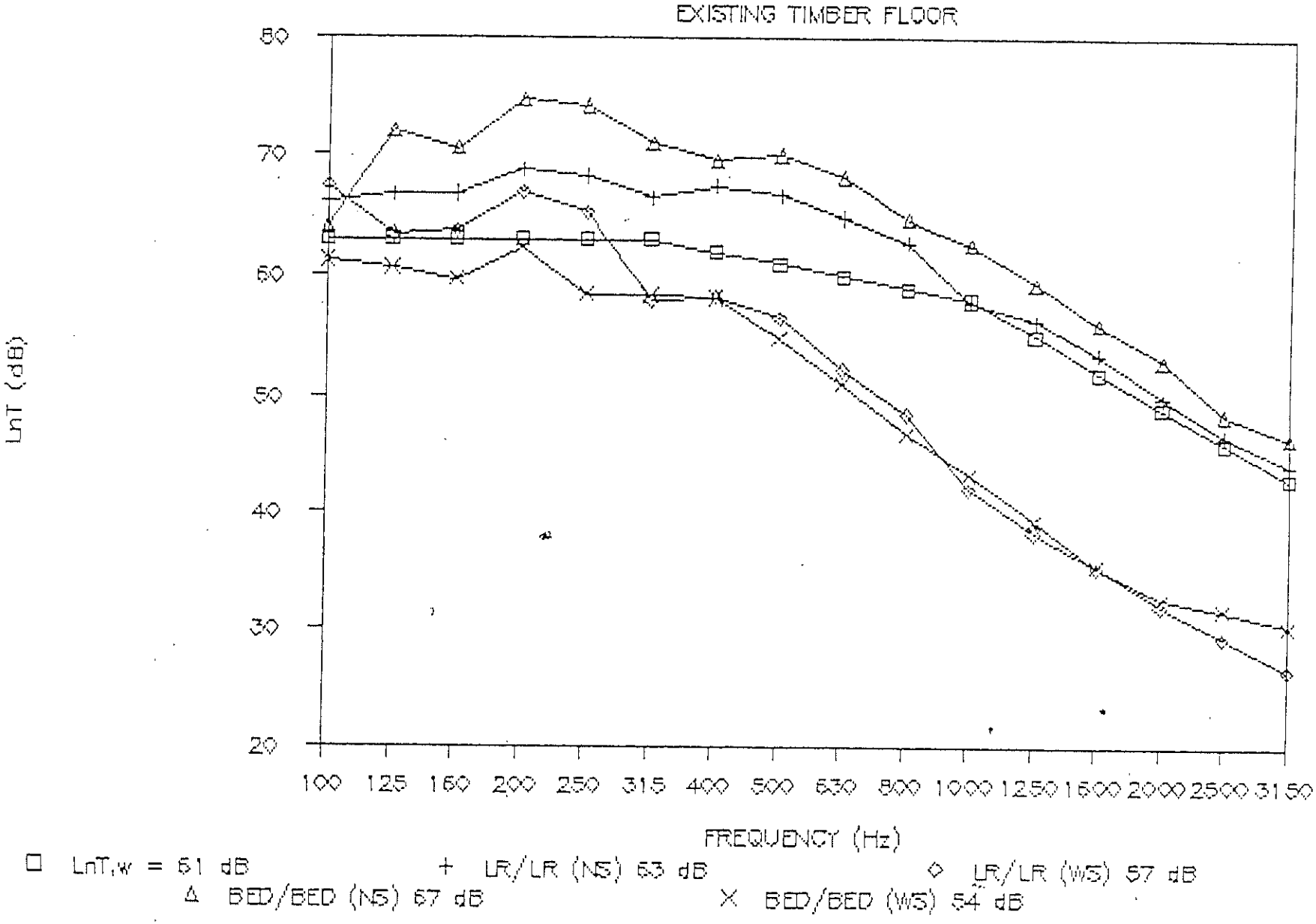

Figure 24: Impact Sound Insulation: Separating floor: Danube St.

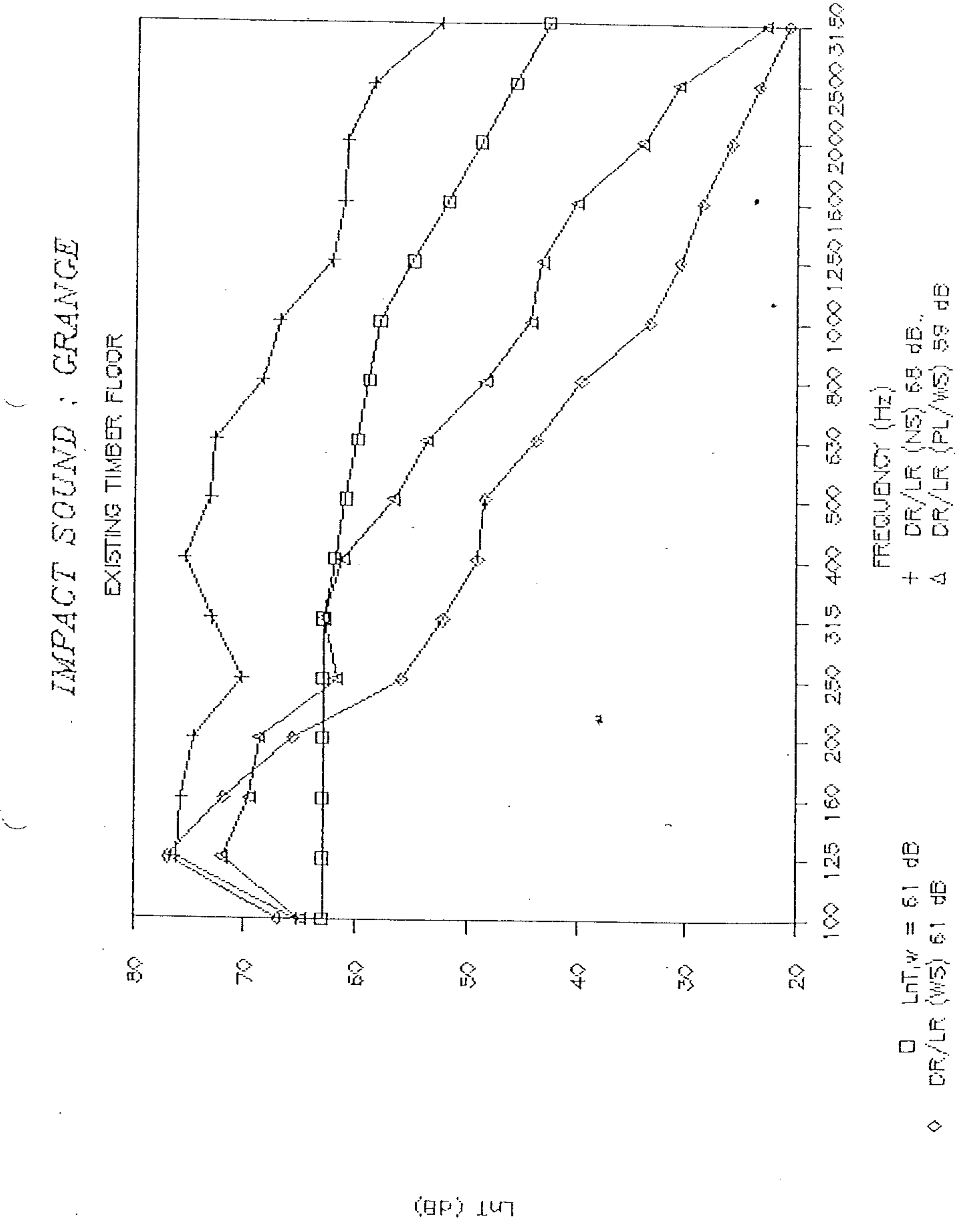

Figure 25: ImpactSound Insulation: Separating Floor: Grange

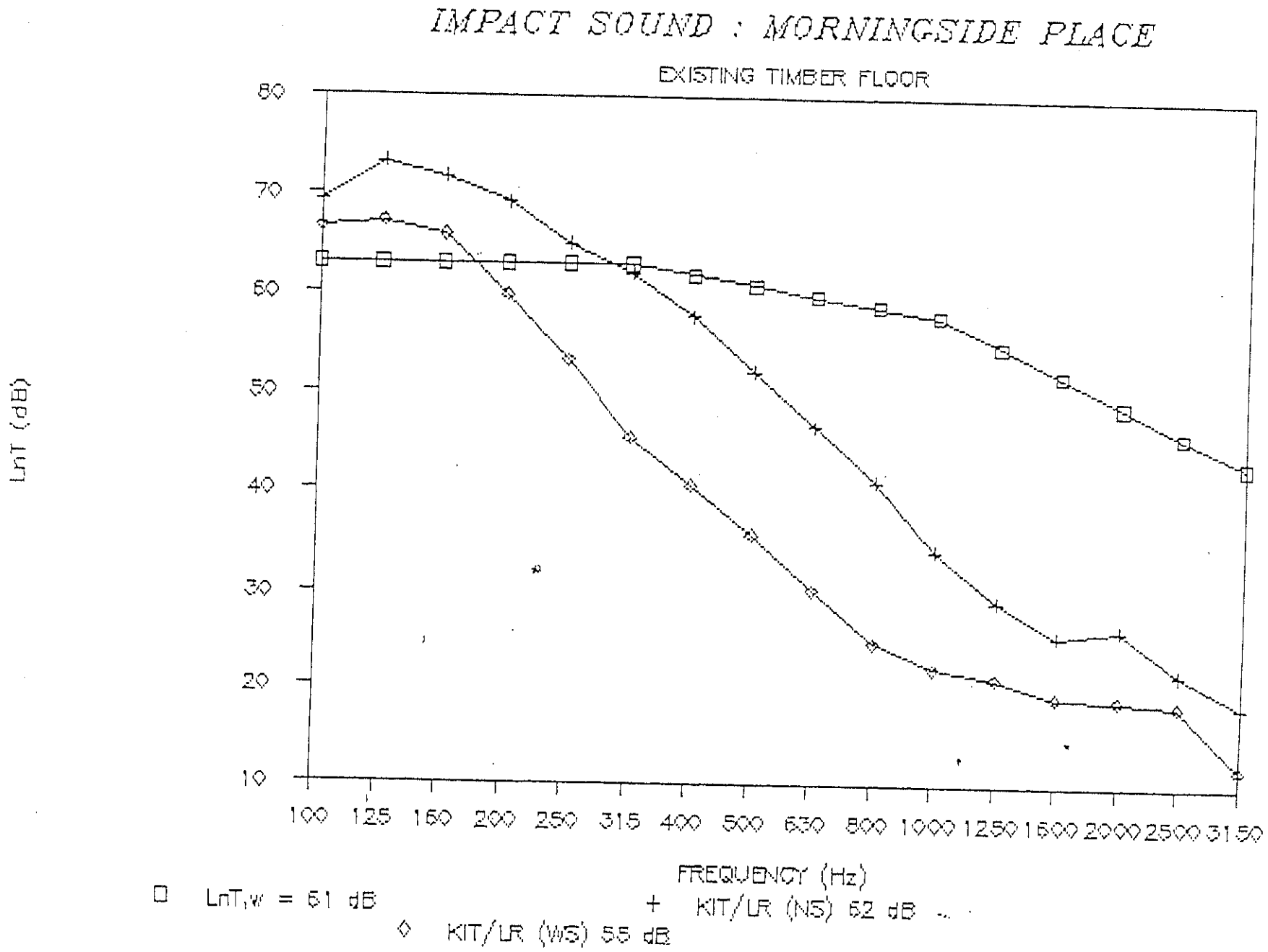

Figure 26: Impact Sound Insulation: Separating Floor: Morningside Place.

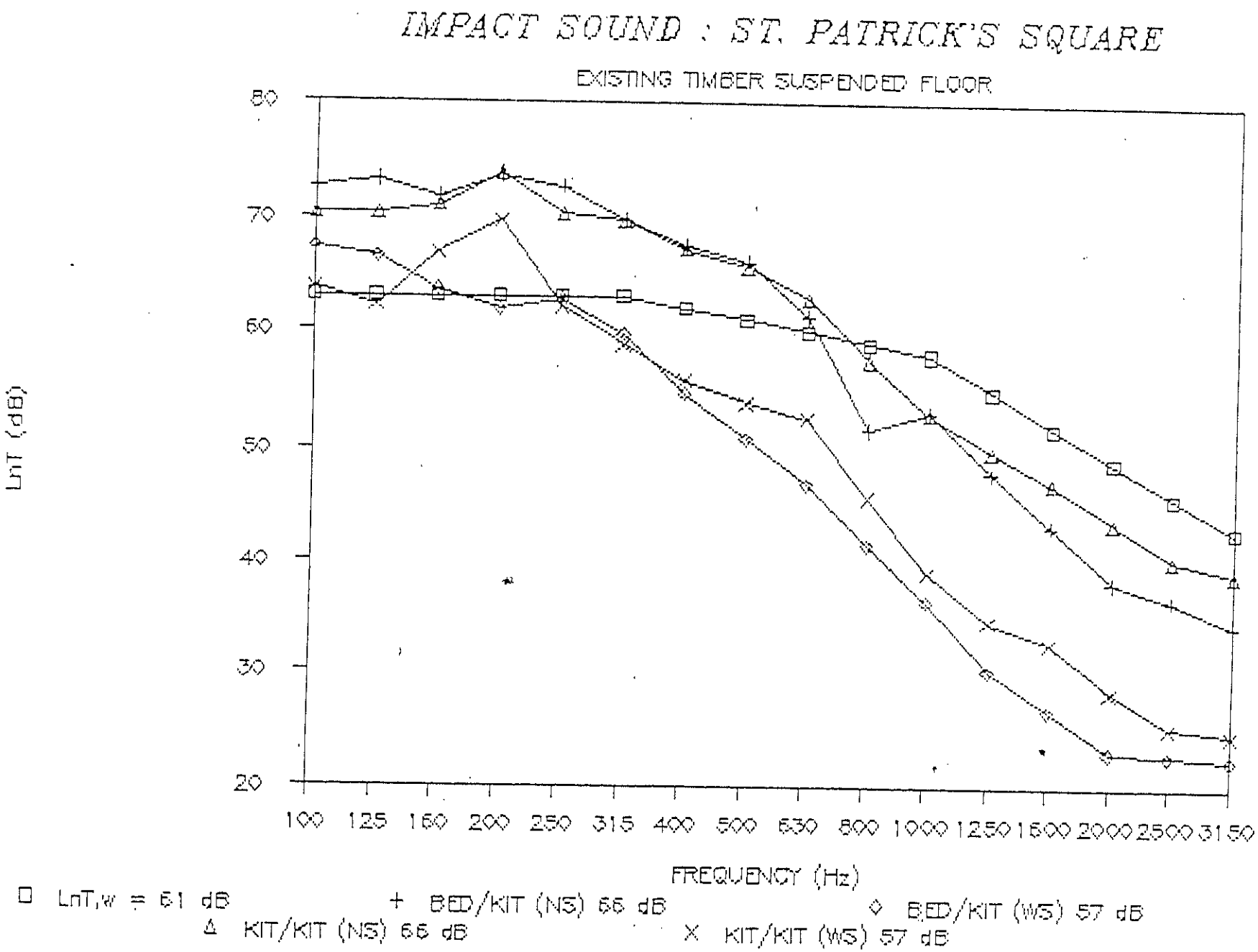

Figure 27: Impact Sound Insulation: Separating Floor: St. Patrick's Square

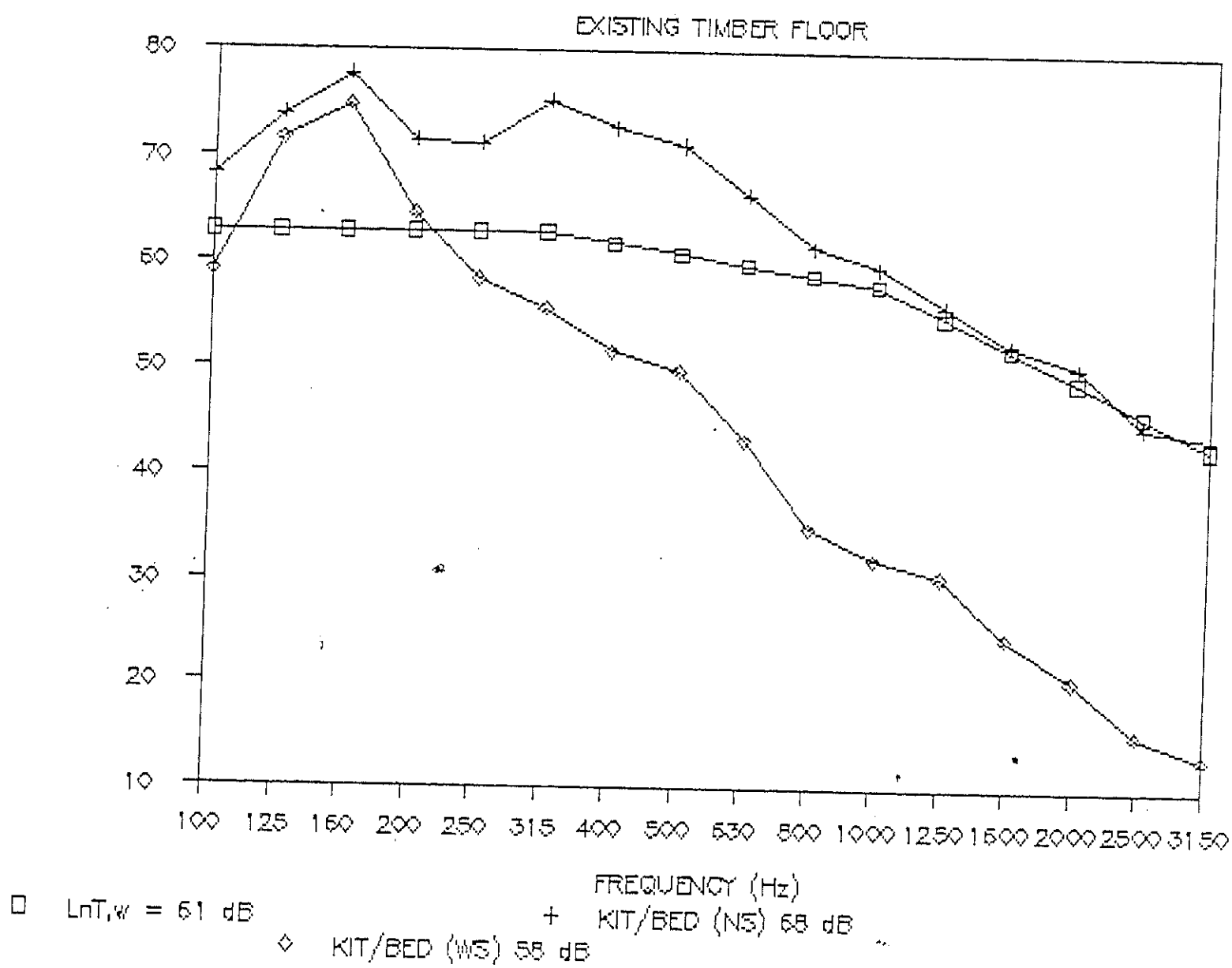

Figure 28: Impact Sound Insulation: Separating Floor: Vietnamese Restaurant.