CINTEL STRUCTURAL CONSULTANTS LTD

Structural Report

Highfield Hall Community Centre, Farnworth

For

Mrs Coleen Thornley

Project No. 95-01

August 2013

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Description of Works

Cintel Structural Consultants Ltd have been employed by Mrs Colleen Thornley following concerns about the ceiling and walls of her nursery moving when "Zumba" dance classes are taking place in the dance room above.

The client has explained that during dance classes the walls appear to bow, and the ceiling deflects considerably, bringing concerns to her about the structural capacity of the building.

The nursery is located on the ground floor of Highfield Hall Community Centre which is a Bolton Council owed property and is situated on Marsh Lane in Farnworth.

Survey Description

The community centre is brick built, two storey has a duo-pitched slated roof with gable ends. The first floor is of timber joist construction which is supported by steel beams running from front to back of the property.

The first floor was partially exposed by the client in order to allow an assessment of the floor construction and allow calculations to be produced for the relevant structural members. Plasterboard had been removed from the underside of three joists and around the supporting beam.

The joists were measured at 215mm x 70mm and visually looked to be of a good quality structural timber. The joists were spaced at circa 400mm centres.

The exposed steel beam measured around 457mm deep and 190mm wide with flanges of around 15mm. The closest Universal Beam section is a 457x191x74.UB and this will be used for the basis of the calculations.

Given that all the ceiling are of the same height, it has been assumed that the same joist and beam sizes have been used throughout.

It was noted that the internal rear wall appeared hollow and was likely to be studded away from the rear masonry wall, and that the plasterboard could clearly be seen to be constructed from the underside of the floor joists above.

From visually inspecting outside, the walls appear to be of cavity construction and we estimate the rebates as around 300mm. Given the wall thickness, we would expect the walls to be brick-cavity-brick construction.

Externally it can be seen that the walls have one brick thick reinforcing piers built into them both at the front of the building and at the back. The piers at the front were approximately in line with the beam lines internally, however; those at the back were spaced at around six metre centres and as such do not line up with the internal beams.

No signs of cracking of the bricks or mortar could be seen and there is no indication of any substantial flexing of the walls.

It is likely that substantial strengthening of the external walls has taken place in the past, and pattress plates and tie bars are visible along the length of the building.

No intrusive investigation was carried out on the masonry wall construction.

Conclusion

Following conducting the survey and calculations, we have assessed each of the elements of the floor and support structure.

Referring to each item individually, the following advice is given:

Timber Floor Joists:

The timber joists are currently undersized for the use as a dance floor. They do not comply to current codes of practice for bending strength and recommended deflection tolerances. We would therefore recommend strengthening works are undertaken.

There are several ways of strengthening the floor and a solution should be designed by a competent structural engineer.

Steel Beams:

The steel beams are adequate and we have no concerns about their structural capacity. No further works are required to these beams.

Walls:

We have no concerns for the load bearing capacity of the masonry walls and we recommend no further work to the masonry. We do however believe the current construction of the internal plasterboard is causing issues. The internal stud/plasterboard wall which forms the rear wall of the building appears to be built directly from the underside of the floor joist above. When the floor joists deflect they could be causing the plasterboard wall to bow. We would therefore advise that a movement joint is provided at the head of the wall to stop the load being transferred into it.

Structural Calculations

Calculations have been produced for the timber joists, steel beams and masonry walls.

The calculations have been carried out in accordance with the following codes of practice:

BS648:1964 – Schedule of Weights of Building Materials
BS6399-1:1996 – Loadings for Buildings – Code of Practice for Dead & Imposed Loads
BS5268-2:2002 – Structural Use of Timber
BS5950-1:2000 – Structural Use of Steelwork in Building

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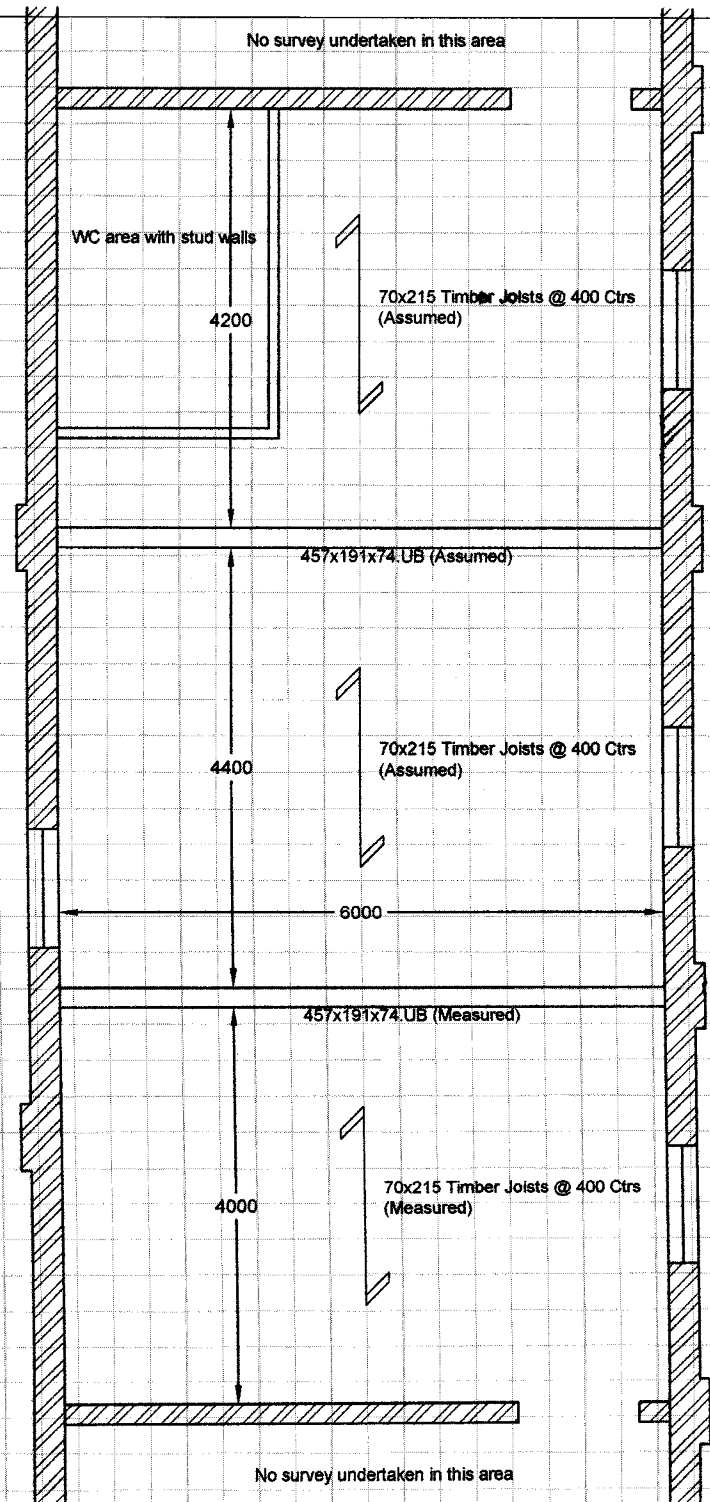
Client: COLLEEN THORNLEY		Date: 12-08-13
		Project No: 95.01
Project: FLOOR STRUCTURE		Sheet No:
		Calc'd by: MDC
CALCULATION SHEET		Checked By: NMP



Ground Floor Plan

All dimensions are in millimeters

LOADING SCHEDULE FOR FIRST FLOOR

DEAD	BOARDING/FINISHES		0.20		(BS648)
	JOISTS		0.15		(BS648)
	CEILING & SERVICES		0.15		(BS648)
		TOTAL	**0.50**	**KN\m^2**	
IMPOSED	DANCE HALL		5.00		(BS6399)
		TOTAL	**5.00**	**KN\m^2**	

The imposed load given is to be treated as a static load, and allows for the dynamic effects associated with dancing on the floor

FLOOR JOISTS (BS 5268-1:2002)

SPAN = 4.4 m
LOADED WIDTH = 0.4 m (Joist Centres)
TOTAL AREA LOAD = 5.5 kN/m^2 (SLS)

JOIST WIDTH = 70 mm
JOIST DEPTH = 215 mm
TIMBER GRADE = C16
BEARING WIDTH = 100 mm (ASSUMED WALLPLATE WIDTH)

TOTAL LOAD = 9.68 kN
MOMENT = 5.32 kN.m
REACTION = 4.84 kN

K - FACTORS

K3 = 1.00 (Long Term Load)
K7 = 1.04 (Depth Adjustment)
K8 = 1.10 (Load Sharing System)

BASIC ALLOWABLE STRESSES

BENDING PARALLEL = 5.3 N/mm^2
COMPRESSION PERPENDICULAR = 2.2 N/mm^2
SHEAR PARALLEL = 0.67 N/mm^2

ADJUSTED ALLOWABLE STRESSES

BENDING PARALLEL = 6.05 N/mm^2
COMPRESSION PERPENDICULAR = 2.42 N/mm^2
SHEAR PARALLEL = 0.74 N/mm^2

BENDING CHECK

Z_{req} = 880348.0 mm^3
Z_{prov} = 539291.7 mm3

SECTION FAILS IN BENDING

SHEAR CHECK

F_v = 0.48 N/mm^2

SECTION OK IN SHEAR

BEARING CHECK

T = 0.69 N/mm^2

SECTION OK IN BEARING

DEFLECTION CHECK

ALLOWABLE DEFLECTION = 13.2 mm

BENDING DEFLECTION = 21.05 mm
SHEAR DEFLECTION = 0.70 mm
TOTAL DEFLECTION = 21.75 mm

SECTION FAILS IN DEFLECTION

ADOPT - 70 x 215 C16 JOISTS @ 400mm CTRS

SIMPLE UDL BEAM LOADING

Beam Reference = 457x191x74.UB

Max Loaded Width =	4.2	m
Max Span =	6	m
Dead Area Load =	0.5	kN/m^2
Live Area Load =	5	kN/m^2
Total Dead Load =	12.60	kN
Total Live Load =	126.00	kN

Refer to Beam Design Output

Cintel Structural Consultants	Project	Highfield Hall Community Centre	Steel Beam Design		
Office A, The Swan Business Centre	Client	Colleen Thornley	Made by	Date	Job No
4 Higher Swan Lane, Bolton, BL3 3AQ	Description	457x191x74.UB	MDC	12-8-13	92.01
info@cscdesign.co.uk			Checked	Revision	Page No
			NMP	-	

Design in accordance with BS 5950 : Part 1 : 1990

Simply supported beam with full lateral restraint

Analysis

Span (m)	6.000

Choose steel section: 457x191x74

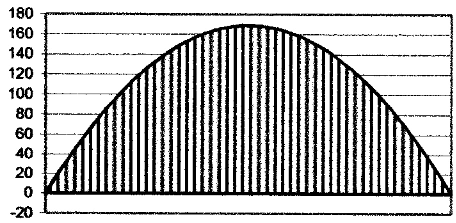
◉ UB
○ UC
○ RSJ
○ PFC

Load Factors	
Dead	1.4
Imposed	1.6

E (N/mm²)	205000
Ix (cm^4)	33320

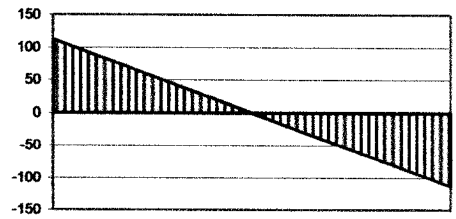
Design Status		capacity ratio
Vertical shear	PASS	0.17
Moment	PASS	0.37
Deflection	PASS	0.31

LOADING	Dead kN	Imposed kN	Position m	Length m
UDL	12.6	126	-	-
Point load				-
Point load				-
Point load				-
Point load				-
Partial UDL				
Partial UDL				



Bending Moment Diagram

RESULTS			
M max	F_V max	Max. deflection (mm)	
		Imposed only	Total load
kNm	kN		
169.02	112.68	-5.19	-5.89



Shear Force Diagram

Design

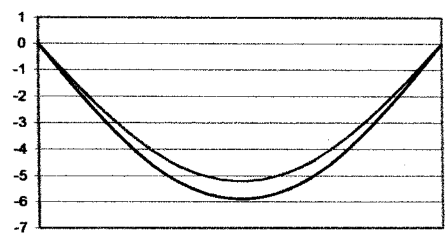
Design Strength	
p_y N/mm²	275

◉ grade S275
○ grade S355

section classification
Plastic

Shear Capacity	
Area A_v	capacity P_v
mm²	kN
4113.0	678.65

cl. 4.2.3



Deflection Diagram

Moment Capacity	Position m	Moment kNm	Fv kN	M_{cx} kNm	Unity Factor
Maximum Moment	3.000	169.02	0.00	454.58	0.37
Critical section	3.000	169.02	0.00	454.58	0.37

* low shear

Z_x (cm³)	1458
S_x (cm³)	1653

Deflection

Deflection Limits		Allowable
span/deflection ratios		mm
Imposed Loads	360	16.7
Total Loads	200	30.0

table 5

Section used:	UB	457x191x74