Influence of Variation of Structural Load Parameters on Structural Load Conversion Factors for Building Foundation Design

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Abstract— This work investigates the influence of differing structural load components and their attendant consequences on structural design load conversion factors for building foundation design purposes. It attempts to delve into the basic load properties/variables that define structural load magnitude alongside its influences on design load values, giving an insight into the dynamics involved in determining load conversion factor (LCF) values. Twenty three (23) 3-dimesional structural models, composed of varying loads types and structural member types/dimensions, were developed and simulated using Orion 18 software to obtain both ultimate loads and service loads, from which the corresponding load conversion factors were determined. The relationships between load conversion factors and their corresponding varying load parameters were determined using Pearson's product moment correlation i.e. Pearson's r. Pearson's Correlation coefficient obtained for Model Group Q was +0.977 implying that increased live load value will resulted to an increase in LCF value. But pearson's correlation coefficient obtained for model groups S, W, B and K are -0.994, -0.975, -0.967 and -1.0 respectively implying that increased slab thicknesses(Model Group S), beam sections(Model Group B), column sections(Model Group K) and inclusion of walls(Model Group W) resulted in decreased LCF values. The study concluded that increase in dead load components of aggregated column foundation load will result in decreased load conversion factor values, but increased live load values, which will lead to increased live load component, will result to an increased LCF values. These increases or decreases are a function of magnitude of their respective loads. Load conversion factors are significantly influenced by live load components. It is therefore imperative for designers and researchers to be aware of the implications of these influences as this will guide and assist them in obtaining a realistic design load estimate as well as understanding the basic details and variables that are constituents and/or determinants of load conversion factor values.

Index Terms— influence, variation, ultimate loads, service loads, load conversion factor.

1 Introduction

THE emergence and utilization of Ultimate Limit State(ULS)-to-Serviceability Limit State (SLS) Load Conversion Factors(LCF) for building foundation design presented an alternative method for computing service loads for the design of foundations for building structures. This was necessitated by the need to seek reliable and suitable alternatives to the common cumbersome and time consuming processes and procedures for converting ultimate load to service loads. It was thus obvious that the utilization of these load conversion factors for obtaining service loads for foundation design purposes greatly simplified load estimation and computation process thus 'psychologically' discouraging the practice of utilising ultimate load in lieu of service loads.

Load conversion factors were majorly specified in BS 5950 part 1: 2000[1] and Oyenuga (2001)[2]. Previous studies appraised existing load conversion factors and pointed out shortcomings inherent in them and further proposed (evolved) new load conversion factors to address these shortcomings. Dakas and Enjugu (2017)[3] reviewed the various existing load conversion factors, established the relevance of load conversion factors alongside the shortcomings inherent in existing values of these load LCF, thus recommending that suitable and appropriate load conversion factors be evolved in this regard. Enjugu, Izam and Dakas (2017)[4] derived values of Load conversion factors alongside an equation, LCF=0.00587qk+1.4092, and recommended them for the aforementioned purpose.

However, the tendency of the LCF yielding very accurate and appreciable outcome is deterred by variations in weight of load components, which are a function of member dimensions and sizes, type and property of material and other design considerations. According to Quimby(2008)[5], values of load conversion factors are influenced by the magnitude of the different types of loads . This implies that varying load types and magnitudes have corresponding effects on load conversion factors and the extent and nature of this influence is a major factor to consider when deriving load conversion factor values. The major loads in a structure are gravity loads i.e live loads and dead loads. The dead loads are induced by self-weight of beams, slabs, walls and columns. Live loads are as

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described and detailed in BS 6399 Part 1: 1984[6] and Eurocode 1 (2002)[7], and vary according to the use to which they are put, or more explicitly the occupancy class or category (i.e in Eurocode 1). Structural member dimensions vary from one structure to another and are a function of structural stability requirements. To arrive at a generally acceptable value of load conversion factor, it is important that the effects of variation in dimensions of structural members and wall partitions type/inclusion including the extent of their influence are known /ascertained and taken into consideration. This step will not only guide in assessing the validity of recently derived values but will also bring to light areas designers need to pay attention to when the use of such conversion factors are considered an option.

2 METHODOLOGY

Modelling and simulation were employed to obtain the data for this study. The modelling and simulation scheme proposed by Velten(2009)[8], and used by Enjugu, Izam and Dakas(2017)[4], was adopted for this study. The methodology used by Enjugu, Izam and Dakas(2017)[4] was also adopted for this study. The scheme involved problem definition, system analysis, modelling, simulation and validation.
In this study, models were developed and simulated for four different Model groups. These model groups include

1. Model group S (varying Slab thickness).
2. Model group W (varying partition wall inclusion and selfweight).
3. Model group B (varying beam cross sectional areas).
4. Model group K (varying columns cross sectional areas).

For each of these model groups, only the varying parameter was varied while all other parameters were kept constant.

2.1 Problem Definition

Two sets of aggregated loads which are the major data for this purpose were required. The first set of aggregated loads are the factored loads or ultimate loads i.e. loads at the ultimate limit state while the second set of aggregated loads are the unfactored loads or working loads i.e. loads at the serviceability limit state. These loads were obtained at the foundation level i.e. foundation loads (ground column loads) computed and collated at both the ultimate limit state and serviceability limit state.

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2.2 System Analysis

The system is a network of reinforced concrete structural members comprising of beams, slabs, columns and walls. Dimensions of structural members adopted are

1. Slab – 150mm thick.
2. Beams – 230mm x 450mm.
3. Walls (sandcrete block) – 230mm thick.
4. Columns – 230mm x 230mm.

The loads on the system consist of dead loads (from slabs, beams, walls, columns, roof and finishes) and live loads. These loads were factored by their appropriate factors of safety (FOS) to obtain values at the ultimate limit state. FOS values of 1.4 and 1.6 were adopted for dead loads and live loads respectively as contained BS 8110 Part 1: 1997[9]. The unfactored loads were taken as values at the serviceability limit state.
Basic weights of various materials adopted are as detailed by Oyenuga(2001)[2] and are as follows:

i. Concrete…………………………..…24.00 KN/m^3
ii. Screed(floor)…….…………………….0.225KN/m^2
iii. 225mm partition block wall …….... 2.87KN/m^2
iv. 150mm partition block wall……….. 2.27KN/m^2
v. Roof live load………………………1.50KN/m^2
vi. Wall finishes (both sides)…….…….. 0.60KN/m^2
vii. 13mm rendering ………………..…. 0.30KN/m^2
viii. 37mm screeding………......….. 0.80KN/m^2
ix. Roofing felt and screed……………. 2.00 KN/m^2
x. Roof live loads –with access…...….. 0.25 KN/m^2
xi. Wood (average)………………….... 8.00 KN/m^2
xii. Asbestos roofing sheet, sheeting rails and nails. 0.40 KN/m^2
xiii. Amiatus and nails…………………0.30 KN/m^2

Live load value of 1.5kN/m^2, obtained from BS 6399 Part1:1984[6], was adopted.

Wall types considered for the study for Model Group W are

i. Model W02 - 100mm thick sandcrete wall
ii. Model W03 - 230mm thick sandrete blockwall
iii. Model W04 - 150mm thick R. C. wall
iv. Model W05 - 230mm thick R. C. wall
v. Model W01 had no wall included(i.e. no partition).

Slab thicknesses considered for Model Group S are

i. Model S01 - 100mm
ii. Model S02 - 125mm
iii. Model S03 - 150mm
iv. Model S04 - 175mm
v. Model S05 - 200mm
vi. Model S06 - 225mm

Beam cross-sectional areas(dimensions) considered for Model Group B are

i. Model B01 - 103500mm^2(230mm x 450mm)

ii. Model B02 - 135000mm²(300mm x 450mm)
iii. Model B03 - 138000mm2 (230mm x 600mm)
iv. Model B04 - 180000mm²(300mm x 600mm)
v. Model B05 - 172500mm²(230mm x750mm)
vi. Model B06 - 225000mm²(300mm x 750mm)

Column cross-sectional areas(dimensions) considered for Model Group K are

i. Model K01 - 52,900mm² (230mm x 230mm)
ii. Model K02 - 90,000mm² (300mm x 300mm)
iii. Model K03 - 103,500mm² (230mm x 450mm)
iv. Model K04 - 160,000mm²(400mm x 400mm)
v. Model K05 - 202,500mm²(450mm x 450mm)
vi. Model K06 - 360,000mm²(600mm x 600mm)

The self-weight and dimensions of the foundations elements were ignored at this stage because it was assumed they are not known and are functions of the aggregated loads from the beams, slabs, walls and columns.

2.3 Modelling

The data enumerated in the system analysis were used in generating the model. The model which incorporated the details above is presented in 2D and 3D as show in figures 1, 2 and 3.

The model was developed using CSC Orion 18 Software, a reinforced concrete design software.

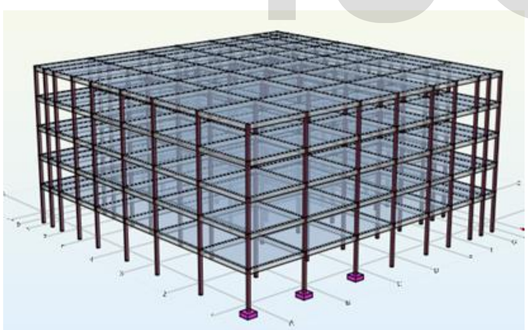

Fig. 1. Typical three dimensional view of reinforced concrete structural model. Source: Enjugu, Izam & Dakas(2017)[4]

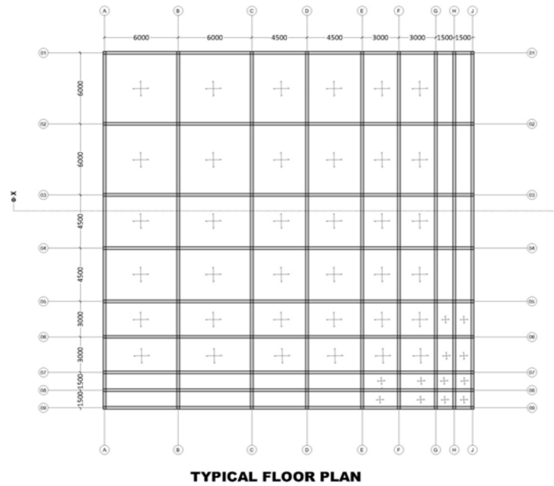

Fig. 2. Typical floor plan of reinforced concrete structural model. Source: Enjugu, Izam & Dakas(2017)[4]

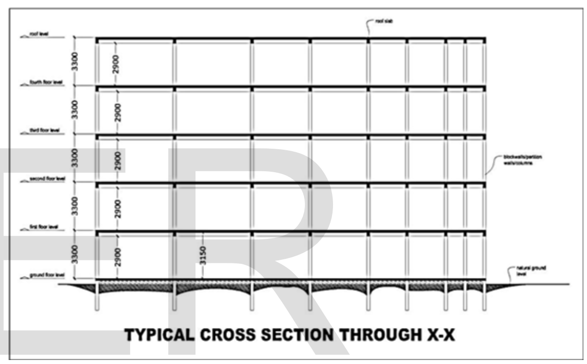

Fig. 3. Typical section through reinforced concrete structural model. Source: Enjugu, Izam & Dakas(2017)[4]

In general, twenty three models were developed to reflect various load situations and are as shown in table 1, except Model Group Q done by Enjugu, Izam & Dakas(2017)[4]. Model group Q comprised of 11 models with differing live load values.

2.4 Simulation

Each model enumerated in table 1 was simulated using CSC Orion 18 Software(2018 version).

2.5 Data Collation and Load Conversion Factor Computation

The loads, ultimate(factored) loads and service(unfactored) loads, on all 81 foundation columns were collated for each model and exported to Microsoft excel Software where the load conversion factor for

TABLE 1
SUMMARY OF MODELS

MODEL GROUP	MODEL	VARYING PARAMETER	
Q	Q01	Live(imposed) load	1.50kN/m^2
	Q02		2.00kN/m^2
	Q03		2.50kN/m^2
(Enjugu, Izam & Dakas 2017)	Q04		3.00kN/m^2
	Q05		4.00kN/m^2
	Q06		5.00kN/m^2
	Q07		7.50kN/m^2
	Q08		9.00kN/m^2
	Q09		10.00kN/m^2
	Q10		12.00kN/m^2
	Q11		20.00kN/m^2
S	S01	Slab thickness	100mm
	S02		125mm
	S03		150mm
	S04		175mm
	S05		200mm
	S06		225mm
W	W01	Wall type/inclusion	No wall
	W02		150mm hollow sandcrete block
	W03		225mm hollow sandcrete block
	W04		150mm R. C.
	W05		225mm R. C.
B	B01	Beam cross sectional area/dimension	103500mm2
	B02		135000mm2
	B03		138000mm2
	B04		180000mm2
	B05		172500mm2
	B06		225000mm2
K	K01	Column cross sectional area/dimension	52900mm2
	K02		90000mm2
	K03		103500mm2
	K04		160000mm2
	K05		202500mm2
	K06		360000mm2

each column was computed. The average load conversion factor for all 81 columns in a model was taken as load conversion factor for the model in consideration.

The load conversion factor is the ratio of the ultimate load to the service loads and the equation is as shown below.

$$LCF = \frac{Ultimate\ loads(F_{ULS})}{Service\ loads(F_{SLS})}$$

Where LCF=load conversion factor,

F_{ULS} = loads computed at Ultimate limit state using load factor of 1.4 and 1.6 for dead and imposed loads respectively,

F_{SLS} = loads computed at serviceability limit state (i.e. loads at their actual state or unfactored loads).

2.6 Analysis of Relationships using Pearson's Product Moment Correlation Coeficient

The relationship between the varying parameters and resulting Load Conversion Factors (LCF) was determined using Correlation analysis. Generally, correlation is used to assess the association between two continuous variables. It measures the degree to which two variables vary together. (Freeman and Young, 2009)[10]

The Pearson's product moment correlation coefficient was computed for each varying parameter i.e. Model type and values of Pearson's *r* obtained from the computation were used to determine the nature of relationship between the load conversion factors and the varying parameters. The computation of the Pearson's *r* was done using Microsoft Excel Software.

A negative relationship between the two variables is indicated by a negative correlation coefficient value and a positive relationship between two variables is indicated by a positive correlation coefficient value. The relationships between the variables were interpreted using Table 2.

TABLE 2
GENERAL GUIDELINES FOR INTERPRETING RELIABILITY COEFFICIENTS

Value Of Pearson's R	Interpretation Of Relationship
Between 0.00 and $\pm$0.25	Zero to weak relationship
Between $\pm$0.26 and $\pm$0.50	Moderately weak relationship
Between $\pm$0.51 and $\pm$0.75	Moderately strong relationship
Between $\pm$0.76 and $\pm$1.0	Strong to perfect relationship

Source: Awotunde & Ugodulunwa (2002)[11]

4 RESULTS AND DISCUSSIONS

4.1 Effects of Varying Live Loads on Load Conversion Factors

The load conversion factors for the various models in model group Q considered are as detailed in table 3.

TABLE 3
LOAD CONVERSION FACTORS FOR VARIOUS LIVE LOADS AND PEARSON'S PRODUCT MOMENT CORRELATION COEFFICIENT FOR MODELS IN GROUP Q

Models	Live load (kN/m^2)	Load Conversion Factor (LCF)
Q01	1.50	1.418
Q02	2.00	1.419
Q03	2.50	1.423
Q04	3.00	1.427
Q05	4.00	1.434
Q06	5.00	1.441
Q07	7.50	1.455
Q08	9.00	1.462
Q09	10.00	1.472
Q10	12.00	1.474
Q11	20.00	1.499
Pearson's product moment correlation coefficient, r	Pearson's r = +0.977	

Source: Enjugu, Izam & Dakas(2017)[4]

From table 3, it will be observed that for model Q1(at 1.50kN/m²), the Load Conversion Factor obtained was 1.418 and for model Q2(at 2.0kN/m²), a Load Conversion Factor of 1.419 was obtained. The load conversion factor increased from 1.419 for model Q3(at 2.5 kN/m²) to 1.423 for model Q3(at 2.50 kN/m²), increasing futher to 1.427 for model Q4(at 3.0 kN/m²), 1.434 for model Q5(at 4.0 kN/m²), 1.441 for model Q6(at 5.0 kN/m²), 1.455 for modelQ7(at 7.5 kN/m²), 1.462 for model Q8(at 9.0 kN/m²), 1.472 for model Q9(at 10.0 kN/m²), 1.474 for model Q10(at 12.0 kN/m²) and 1.499 for modelQ11(at 20.0 kN/m²) respectively. The relationship between the live load values adopted for this work and the Load Conversion Factors obtained was determined using Pearson's product moment correlation coefficient. The value of Pearson's r obtained was +0.977. This indicated a perfect positive relationship between the two items. This also implies that as live load values increases, the load conversion factor also increases.

4.2 Effects of Varying Slab Thicknesses on Load Conversion Factors

Values of the resulting load conversion factors for each model are presented in table 3. The relationship between the load conversion factors obtained and their corresponding slab thickness as adopted for this work was determined using Pearson's product moment correlation coefficient and the Pearson's r also included in table 4.

TABLE 4
LOAD CONVERSION FACTORS FOR FOR VARIOUS SLAB THICKNESSES AND PEARSON'S R

Model group	Slab Thickness(mm)	Load Conversion Factor (LCF)
S01	100	1.4166
S02	125	1.4157
S03	150	1.4152
S04	175	1.4146
S05	200	1.4140
S06	225	1.4136
Pearson's product moment correlation coefficient, r	Pearson's r = -0.994	

From table 4, it will be observed that at slab thickness of 100mm, a load conversion factor value of 1.4166 was obtained, and at slab thickness of 125mm, the load conversion factor value obtained was 1.4157. At slab thickness of 225mm, load conversion factor value reduced to 1.4136. It can be observed, from table 16 above that as the slab thickness increased from 100mm to 225mm, the load conversion factor value decreased from 1.4166 for model S01 to 1.4157 for Model S02, 1.4152 for Model S03, 1.4146 for Model S04, 1.4140 for Model S05 and 1.4136 for Model S06. An increase in the thickness of the slab resulted in an increase in the dead load component of the slab. This in turn increased the dead to live load ratio which further translated to a decrease in the ratio of the ultimate load to the service load, and hence the load conversion factor.

The value of -0.994 obtained as Pearson's product moment correlation coefficient indicated a perfect negative correlation between the values of slab thicknesses considered and their corresponding resulting load conversion factors. This implies that increasing the thickness of slab resulted in a decrease in the load conversion factor.

4.3 Effects of Varying wall types/inclusion on Load Conversion Factors

The wall types adopted were carefully chosen to reflect varying wall weights on beams of reinforced concrete structures.
The resulting load conversion factors obtained for each model (i.e W01 to W05) are summarised in table 5.
The models detailed in table 5 are defined by the respective weights of wall. Model W01 has no wall hence a wall self-weight value of 0.0kN/m² was adopted. Models W02, W03, W04 and W05 had wall selfweight values of 2.87kN/m², 3.47kN/m², 3.60kN/m² and 5.52kN/m² respectively. The major difference between the model subgroups here are the various unit weights of walls imposed on beams and as such, this discussion focused more on the unit weights rather than wall types and sizes(thicknesses).

TABLE 5
LOAD CONVERSION FACTORS FOR VARIOUS WALL TYPES AND PEARSON'S R FOR MODELS IN GROUP W

Model	Weight (kN/m^2)	Load Conversion Factor (LCF)
W01 (No wall)	0	1.4296
W02(150mm thick sandcrete blockwall)	2.87	1.4176
W03(230mm thick sandcrete blockwall)	3.47	1.4160
W04(150mm thick R. C. wall)	3.60	1.4148
W05(230mm thick R. C. wall)	5.52	1.4118
Pearson's product moment correlation coefficient, r	Pearson's r = -0.975	

From table 5, it was observed that at wall unit weight 0.0kN/m², the load conversion factor obtained was 1.4296 but at 2.87kN/m² wall unit weight, the load conversion factor reduced greatly to 1.4176 by a value of 0.0120. This implies a significant effect of the wall loads on load conversion factors. This also establishes the fact that wall inclusion significantly increases the dead load component of ultimate loads. The load conversion factor further reduced from 1.4176 for W02 to 1.4160 for W03, 1.4148 for W04 and 1.4118 for W05, the difference being 0.0048 between 1.4176 for W02 and 1.4118 for W05.

The relationship between the Load conversion factors and their corresponding unit weights of walls was determined using Pearson's product moment correlation coefficient and Pearson's correlation coefficient obtained was -0.98 indicating a perfect negative correlation. This implies that inclusion of partition walls or increasing wall selfweights will lead to a decrease in load conversion factor value.

Walls contribute significantly to the dead load component of column ultimate loads as such; their effect on load conversion factors is evident in the decreasing load conversion factor values.

4.4 Effects of Varying beam Dimensions/Cross-Sectional areas on Load Conversion Factors

Values of load conversion factors obtained for the various models considered here are presented in Table 18. The relationship between the load conversion factors obtained and their corresponding beam cross-sectional areas was determined using Pearson's product moment correlation coefficient and the Pearson's r also included in table 6.

From Table 6, it was observed that at B01(103500mm²), a load conversion factor value of 1.4180 was obtained. At B02(135000mm²), a load conversion factor value of 1.4180 was also obtained. But load conversion factor value reduced from 1.4180 for B02(135000mm²) to 1.4177 for B03(13800mm²), 1.4172 for B04(180000mm²), 1.4170 for B5(172500mm²) and 1.4165 for B06(225000mm²). It was also observed that as the cross-sectional area of the beam increases, the load conversion factor decreases.

TABLE 6
LOAD CONVERSION FACTORS FOR VARIOUS BEAM DIMENSIONS/CROSS SECTIONAL AREAS AND PEARSON'S R FOR MODELS IN GROUP B

Model	Beam Cross Sectional Area (mm^2)	Load Conversion Factor (LCF)
B01 (230mm x 450mm)	103500	1.4180
B02 (300mm x 600mm)	135000	1.4180
B03 (230mm x 450mm)	138000	1.4177
B04 (300mm x 600mm)	180000	1.4172
B05 (230mm x 750mm)	172500	1.4170
B06 (300mm x 750mm)	225000	1.4165
Pearson's product moment correlation coefficient, r	Pearson's r = -0.967	

Obviously, an increased cross-sectional area implies increased selfweight of the beam. This resulted to an increase in the dead load component of the resulting aggregated loads which in turn lead to a reduction in load conversion factor.

The nature of relationship between the load conversion factors between the beam cross-sectional areas and the resulting load conversion factors in Table 5 was determined using Pearson's product moment correlation coefficient and Pearson's correlation coefficient obtained was -0.967, indicating a perfect negative relationship. This implies that as cross sectional area of beams increase, the load conversion factor decreases.

Overall, it can be deduced that an increase in beam cross-sectional area will result to a decrease in load conversion factor. This decrease can be considered approximately insignificant as the difference between the highest and lowest value of load conversion factors contained in table 7 is 0.0015.

4.5 Effects of Varying Column Dimensions/Cross-Sectional areas on Load Conversion Factors

The load conversion factors obtained for the various models considered here are summarised in Table 7. The relationship between the load conversion factors obtained and their corresponding column cross-sectional areas determined using Pearson's product moment correlation coefficient and the Pearson's r also included in table 7.

From Table 7, it was observed that for Model K01, a load conversion factor value of 1.4152 was obtained. For Model K02, 1.4149 was obtained as the load conversion factor. The load conversion factor further reduced from 1.4149 for Model K02 to 1.4148 for Model K03, 1.4144 for Model K04, 1.4140 for Model K05 and 1.4129 for Model K06.

It was also observed that as column cross-sectional area increased, the load conversion factor decreased. This can be attributed to a corresponding increase in the dead load component of the collated loads.

Pearson's product moment correlation coefficient was used to determine the nature of relationship between the beam cross sectional areas and the load conversion factors, and detailed in Table 7. Pearson's correlation coefficient obtained was -1.0 thus indicating a perfect negative correlation between the column cross-sectional area and the resulting load conversion factor. This implied that an increase in column cross-sectional area resulted to a decrease in load conversion factor

TABLE 7
LOAD CONVERSION FACTORS FOR VARIOUS COLUMN DIMENSIONS/CROSS SECTIONAL AREAS AND PEARSON'S R FOR MODELS IN GROUP K

Model group	Column Cross Sectional Area (mm^2)	Load Conversion Factor (LCF)
K01 (230mm x 230mm)	52,900	1.4152
K02 (300mm x 300mm)	90,000	1.4149
K03 (230mm x 450mm)	103,500	1.4148
K04 (400mm x 400mm)	160,000	1.4144
K05 (450mm x 450mm)	202,500	1.4140
K06 (600mm x 600mm)	360,000	1.4129
Pearson's product moment correlation coefficient, r	Pearson's r = -1.0	

value. This is also because when column cross-sectional area is increased, the selfweight of the column is increased, thus leading to an increase in the dead load component of the resulting aggregated loads and consequently a decrease in load conversion factor value.

4.6 Observations on Load Coversion Factor Values of Model Groups

The ranges of values obtained for each model group are collated and summarized in Table 8 below.

TABLE 8
RANGE OF LCF VALUES OBTAINED FOR THE VARIOUS MODEL GROUPS

Model Group	Highest Value of LCF	Lowest Value of LCF	Range	Percentage	Position
Q	1.4986	1.4183	0.0803	78.8	1
S	1.4166	1.4136	0.0030	2.94	3
W	1.4296	1.4148	0.0148	14.52	2
B	1.4180	1.4165	0.0015	1.47	5
K	1.4152	1.4129	0.0023	2.26	4

From the Table 8, it was observed that Model group Q (live load) ranks high with a range of 0.0803, thus implying that its effect on load conversion factor is very significant. Wall types and inclusion i.e. Model group W ranks 2nd with a range of 0.0148, with some degree of influence on the resulting Load Conversion Factor, which is largely due to wall inclusion. Where partition walls are absent, its effect is zero. Model group S(Slab thickness) ranks 3rd with a range of 0.003 while Model group K(column cross-sectional area) and Model group B(beam cross-sectional area) ranks 4th and 5th with ranges of 0.0023 and 0.0015 respectively. It is thus evident that influence of varying beam dimensions, beam cross-sectional area and column cross sectional area on load conversion factors are not significant. But varying live load values and wall inclusion have significant effects on load conversion factor values.

5 CONCLUSION AND RECOMMENDATION

Load Conversion Factor values are significantly influenced by live loads. Inclusion of walls also has some influence on LCF values, but these influences are approximately minimal. Absence of partition walls automatically implies its zero effect. The influence of changes in slab depths, beam and column sections have very minimal or no effects on the load factors in consideration.
Though sound engineering judgement is important, Structural designers should as well note these varying parameters alongside their implications on LCF during computation of load estimates. This will greatly assist in arriving at a more realistic and reliable design load estimate.

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