Awareness and Adoption of Light Gauge Steel (LGS) Technique in the Construction Industry

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Abstract
Light Gauge Steel (LGS) construction has been a well embraced building technique in the developed countries for many years. However, it is an unpopular method of construction in the developing countries, including South Africa. The aim of this study is to gain insight into the level of awareness and adoption of LGS technique in the construction industry. The survey research design was adopted for this study. Questionnaire was administered on large contracting and consulting firms in South Africa using the random sampling technique. The data for the study was analysed with frequencies, percentages, mean item scores and t test statistics. The results of the study indicate the perceived percentage level of awareness and adoption of LGS technique in the construction industry. The mean ratings of variables according to consultants and contractors were also indicated in the study. It was also concluded that light gauge steel is adopted for construction in South Africa, but it is mostly used as wall elements. The study recommends that, there is need for more awareness on the usefulness and need to adopt LGS for construction industry.

Keywords
Conventional construction, construction professionals, green building technique, Light gauge steel.

1. Introduction

Light Gauge Steel (LGS), also known as Lightweight Steel is a cold-rolled steel product, commonly available in the shape of flat sheets, angles, or channels and often used to frame non-structural partitions (Lapedes 1978). LGS structures are outstanding buildings in Australia, the United States and Europe. It has been in use for over 50 years now (Barnard, 2011). It is utilized for all types of structures, be it public, private, offices, schools, hospitals, churches etc. In spite of the long years of adoption of LGS, it is surprising that it is not a popular construction technique in developing countries, including south Africa. Some of the reasons may be attributed to the awareness of the construction technique in developing countries. Hence, this research investigates the level of awareness and adoption of LGS construction technique in South Africa.

2. Literature Review

Developing the awareness of LGS is one of the essential requirements of South African Light Steel Frame Association (SASFA) for sustainable and environment-friendly building strategy. The intended interest groups for LGS include designers, quantity surveyors, engineers, developers, material suppliers and clients. The Southern African National Standards (SANS) is responsible for ensuring that standard materials are used for construction. According to Kozlovská and Spisáková (2013) and Hauke, et al. (2016), there is little knowledge on the outcome of recycled materials such as LGS. However, AISI (2010) noted that LGS has transformed into an always wanted construction material. Despite the crave to adopt LGS for construction in many parts of the world, its awareness in developing countries like South Africa remains low. In view of this, the Steel Market Development Institute (SMDI) took the step to improve the awareness of LGS in the construction business and influence different companies to upgrade to LGS (AISI, 2010).

The LGS framed structures were recommended as the general construction technique in the Building Standard Law of Japan (Hayashi, 2012). The National Construction Association (NCA) recognized innovative approaches for achieving affordable housing at the state and local levels (Schroder, 2010). Mittal *et al.* (2008) noted that, when a client decides to use steel for construction, the decision was made with great knowledge of the awareness of the usefulness of each of its components. Mittal et al. (2008) further explained that the construction team was aware of the fact that, steel is a type of recyclable material which offers importance to the building industry.

Barnard (2011) stated that there is need to have construction principles for LGS frameworks just as there are frameworks for stone work and cement. Akinboade and Mkowena (2012) noted that, new construction innovation is always more expensive than what it replaces. Building and Construction Authority (2016) explained that LGS could be used for ceiling joist, floor joist, wall stud, structural sheathing, load bearing studs, cold-forming, flange flat strap, galvanised steel, clip angle, framing, non-load bearing wall and rafter. Chini and Gupta (1997) added wall studs and roof trusses to the list of where LGS can be used.

LGS can also be used as lightweight cladding, curtain wall and drywall framing (Kumba Iron Ore, 2013). The Japan Iron and Steel Federation (2012) noted that, LGS was adopted as exterior wall panels, wall framing, partitions and roof truss. Hayashi (2012) further explained that LGS could be utilized for industrial structures such as truss rooftop framework or complete frame. Coskun (2007) stated that LGS can be used in segmental sizes of hot rolled steel for framing structure or as additional building parts.

Schroder (2010) informed that LGS may be used as a floor framing system with all types of known flooring materials such as plywood, floor tiling, Oriented Standard Board (OSB) concrete-filled steel deck and even fibre reinforced cement board. According to Lyons (2009), the Americans have changed from building of homes with the timber frame to cutting and assembling of structural steel frames with LGS. Coskun (2007) affirmed that, adopting LGS as an alternative method of construction is a positive and effective choice for construction. Despite the beneficial uses of LGS, it has not gained popularity in developing countries

including South Africa. This study seeks to investigate the level of awareness and adoption LGS in the construction industry.

3. Research Methodology

In this research, the quantitative and qualitative methods were used. The study was conducted within Johannesburg and Cape Town. The questionnaire was served on construction professionals (contractors/builder, construction managers, architects, quantity surveyors, project managers and engineers) that were engaged on LGS projects. The construction professionals were located within various construction companies in Johannesburg and Cape Town. The questions used to obtain information on the study was based on a 5-point Likert scale. The purposive sampling technique was used for this study because there are not many LGS based projects in the South Africa, hence the need to purposely serve the questionnaire on LGS projects. The frequency, sum and Mean Item Score (MIS) were used to analyse the data for the study.

4. Data Analysis

Table 1 displays the profession of the respondents. Results show that 25.0% of the respondents were architects, 16.67% were project managers, 13.89% were developers, 8.33% were quantity surveyors, 5.66% were engineers and 30.56% were in other professions.

Table 1: Profession of respondents

Profession	Percentage
Architects	25.00
Project managers	16.67
Developers	13.89
Quantity surveyors	8.33
Engineers	5.66
Others	30.56
Total	100

Table 2 displays the Professional bodies of the respondents. Results show that 52.78% are with SASFA; 16.67% are with SACPMCMP; 11.11% are with SACQSP and Other professional bodies; 8.33% are with CEA.

Table 2: professional body of respondents

Professional body	Percentage
SASFA	52.78
SACPMCMP	22.78
SACQSP	16.11
Others	8.33
Total	100.00

Table 3 displays the type of civil engineering projects handled by respondents. Results show that 70% were structural, 20 % were roadworks and 10% were other civil engineering projects.

Table 3: type of projects handled by respondents

Type of project	Percentage
Structural woks	70.0
Roadworks	20.0

Other civil engineering	10.0
Total	100.0

Table 4 explores the level of awareness of Light gauge steel construction in the construction industry. The results indicate that, among the uses of LGS, respondents' awareness is in the order of wall framing (3.97), floor joist (3.94), interior wall panel (3.86), load bearing wall stud (3.86), and structural sheathing (3.81). The areas of use with least awareness are Deck/slab (2.92), mounting joist (2.67), binder (2.58), heel (2.58) and node (2.47) respectively.

Table 4: Awareness of Light Gauge Steel construction

Areas of use of LGS	N	Mean	Std. Deviation	Rank
Wall framing	36	3.97	1.230	1
Floor joist	36	3.94	1.413	2
Interior wall panel	36	3.86	1.334	3
Load bearing wall stud	36	3.86	1.222	4
Structural sheathing	36	3.81	1.191	5
Exterior wall panel	36	3.81	1.431	6
Rafter	36	3.78	1.290	7
ceiling joist	36	3.75	1.339	8
Strut	36	3.72	3.591	9
Non-load bearing wall stud	36	3.53	1.362	10
Purlins	36	3.44	1.403	11
Lower floor top plate	36	3.28	1.485	12
Upper floor bottom plate	36	3.28	1.386	13
Kingpost	36	3.22	1.456	14
Bottom track	36	3.19	1.431	15
bottom chord/tie beam	36	3.17	1.521	16
Floor stud	36	3.14	1.496	17
Ridge	36	3.11	1.469	18
Top track	36	3.03	1.483	19
top chord	36	3.00	1.394	20
Web	36	3.00	1.549	21
ceiling batten	36	3.00	1.474	22
Side beam	36	2.97	1.444	23
Cross beam	36	2.97	1.464	24
Deck/slab	36	2.92	1.628	25
Mounting joist	36	2.67	1.394	26
Binder	36	2.58	1.381	27
Heel	36	2.58	1.381	28
Node	36	2.47	1.298	29

Table 5 indicates the level of adoption of light gauge steel construction in the construction industry. Floor joist was the most adopted LGS (3.64) followed by interior wall panel (3.61), wall framing (3.53), structural sheathing (3.50), load bearing wall with stud (3.47). the least adopted LGS are mounting joist (2.39), cross beam (2.39), top chord (2.33), node (2.28) and binder (2.19) respectively.

Table 5: Adoption of Light Gauge Steel construction				
Areas of use of LGS	**N**	**Mean**	**S.D**	**Rank**
Floor joist	36	3.64	1.313	1
Interior wall panel	36	3.61	1.460	2
Wall framing	36	3.53	1.424	3
Structural sheathing	36	3.50	1.384	4
Load bearing wall stud	36	3.47	1.362	5
Exterior wall panel	36	3.47	1.576	6
Non-load bearing wall stud	36	3.28	1.523	7
Rafter	36	3.14	1.417	8
Lower floor top plate	36	3.06	1.286	9
Ceiling joist	36	3.03	1.444	10
Kingpost	36	2.89	1.326	11
Web	36	2.89	1.563	12
Purlins	36	2.86	1.417	13
Upper floor bottom plate	36	2.81	1.369	14
Floor stud	36	2.81	1.348	15
Strut	36	2.78	1.476	16
Bottom track	36	2.78	1.290	17
Top track	36	2.75	1.204	18
Ridge	36	2.64	1.355	19
ceiling batten	36	2.58	1.500	20
bottom chord/tie beam	36	2.58	1.481	21
Side beam	36	2.56	1.443	22
Deck/slab	36	2.50	1.540	23
Heel	36	2.42	1.538	24
Mounting joist	36	2.39	1.420	25
Cross beam	36	2.39	1.337	26
top chord	36	2.33	1.454	27
Node	36	2.28	1.323	28
Binder	36	2.19	1.451	29

5. Discussion of findings

These findings are in total agreement with the findings of APTA (2005) that LGS in construction are used for ceiling joist, floor joist, wall stud, structural sheathing, load bearing studs, cold-forming, flange flat strap, galvanised steel, clip angle, framing, non-load bearing wall and rafter accordingly. The results are also in agreement with the findings of Chini and Gupta (1997) which states that LGS is used for wall studs and roof trusses. The Japan Iron and Steel federation (2012) explained that LGS was adopted for exterior wall panels, wall framing, partitions and the roof truss. Therefore, going by the findings of this study, the awareness of LGS is highest on wall elements rather than roof and floor elements. The implication of the

above findings is that, construction professionals in the construction industry need to get more awareness on the use of LGS as roof and floor elements.

6. Conclusion

Based on the findings of the study it was concluded that respondents' level of awareness of LGS construction is slightly above average; however, they are more aware of the use of LGS as wall elements and not floor and roof. This is evident in their ratings as wall framing has the highest mean score. In line with the level of awareness, the results of the study show that respondents adopt LGS mostly for wall elements. Therefore, the study concludes that LGS is only currently used for wall elements in the South African construction industry. In addition, the study concludes that, adoption of LGS is determined by the level of awareness of LGS. Therefore, the study recommends that, more awareness should be created on the use of LGS for wall, roof and floor respectively. Organizations should have regular workshops and conferences to enlighten more people on the awareness of LGS for construction.

References

Akinboade, O. A. and Mkowena, M. P. (2012) Drivers of housing technology adoption in South Africa, Journal of Geography and Regional Planning, 5 (12) 328-338

American Iron and Steel Institute (2010) American specification for the design of cold-formed steel structural members. Obtained from www.steel.org on 18th March 2017

Barnard, D. (2011). Light steel construction and modular homes as alternative building methods in South Africa. A thesis of the faculty of engineering, built environment and information technology, University of Pretoria, South Africa.

Building and Construction Authority (2016) Design guide on the use of alternative structural steel. Obtained from www.bca.gov.sg on 18th March 2017

Chini, A. and Gupta, K. (1997) A Comparison Between Steel and Wood Residential Framing Systems. Journal of Construction Education, 2 (2) 133 - 145

Hauke, B., Kuhnhenne, M., Lawson, M. and Veljkovic, M. (2016). Sustainable Steel Buildings: A practical guide for structures and envelopes. Wiley Blackwell.

Hayashi, S. (2012) Characterization Techniques for Development of Products and Processes in the Steel Industry. Nippon Steel Technical Report, 101, 138-143

Kiymaz, G., Coskun. E., Cosgun, C. (2007) Behavior and design of seam-welded stainless steel circular hollow section flexural members. Journal of Structural Engineering, ASCE, 133 (12) 1972-1800.

Kozlovska, M. and Spisakova, M. (2013). Construction waste generation across construction project life-cycle. Organization, Technology and Management in Construction, 5 (1) 687-695

Kumba Iron Ore (2011) An overview of the South African iron and steel value chain. Obtained from www.adcommission.gov.au on 18th March 2017

Lapedes, D. N. (1978). Dictionary of scientific and technical terms. Obtained from www.abebooks.com on 18th March 2017

Lyons, A. (2007). Materials for architects and builders. Taylor and Francis, Newyork

Mittal, L. M. (2008). Safe sustainable steel. Obtained from www.aperam.com on 18th March 2017

Schroder, D. L. (2010) The steelmaker's considerations when evaluating raw materials. obtained from citeseerx.ist.psu.edu on 18th March 2017