



Training Artisans On-Site

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Abstract

The decline in apprenticeship in both the public and private sectors, the increasing use of sub-contractors as well as the uncoordinated approach in the informal sector are contributing factors to the shortage of skilled artisans in the construction industry. Artisans' training can be introduced and implemented through the adoption of progressive implementation of construction processes commencing work from areas with low skills requirements to areas of high skills demand. The success of this principle hinges on the collaborative effort of the key project stakeholders. The client should be willing to absorb extra cost and delays in the project; the design and contract documentation should facilitate on-site training, and consultants actively guide the contractor and the construction processes to achieve training objectives.

The exploratory research method was adopted in this study and research revealed that this principle was used in a project in the UK and in the development of infrastructure for the tourism industry of South Africa. It is recommended that the principle be adapted by the public sector for the development of small size infrastructures that can be repeated in many places. This will boost the quality and quantity of artisans, enhance employability, reduce rural urban migration and alleviate poverty.

Keywords: Skilled artisans, On-site training, Progressive construction processes, Project stakeholders, Contract documentation

Introduction

The demands of training artisans on-site in terms of cost, commitment, low initial return on investment and piracy are some of the factors restraining many construction firms from active participation. That notwithstanding, the medium size firms and the informal sector are still engaging in some form of training. The informal sector adopts fragmented training depending on the relationship of the trainee to the independent foremen, their regular team member or the subcontractor. The quality of training is compromised especially if the trainee is outside the close relations of the trainer (Stretton, 1981, Abdul-Aziz, 2001). Though the public and the formal sector are not too active in training artisans and the informal sector's approach is not coordinated, the approach being experimented by the medium size firms in South Africa- the progressive implementation of construction processes- holds potential solution to the dearth of skilled artisans in the construction industry. The principles involves the active participation of the design team, client and the contractor commencing construction work from areas that require low skill demand and progressing to areas of higher skills demand.

The focus of this paper is the propagation of the use of progressive implementation of the construction process in any particular project, commencing construction works from the simple to more complex areas of the project as an effective tool for skill development. The fund for training can be integrated into the contract value and the supervising authorities or consultant

could double as facilitators, not merely performing their statutory duties. The principle is being used in the development of infrastructures in the tourism industry of South Africa.

The Trend in the Construction Industry

The increase in the use of subcontractor (specialist or labour only contractors) in the construction industry worldwide is posing challenges to the stability of employment and skill development in the industry. During the tripartite meeting of ILO in Geneva 2001, entitled, 'The Construction Industry in the Twenty-first Century: Its Image, Employment Prospects and Skill Requirements', the use of labour subcontracting and its effects on the status of construction workers featured prominently. Evidence from China showed that the proportion of employees in the Chinese construction industry declined drastically, from 72 percent in 1980 to 35 percent in 1999, (Lu and Fox, 2001). Interviews conducted among 3,300 construction workers in Sri Lanka revealed that 82 percent of the skilled workforce and 93 percent of the unskilled workforce are employed on temporary basis, either as casual workers or through labour contractors, (Jayawardane and Gunawardena, 1998). The picture is not different in the Philippines where 85 percent of the estimated 1.35 million wage and salaried workers in the construction industries as at January 2000 were temporary workers or project-based employees (Yuson, 2001). Two separate reports from India shows that 73 percent of the construction workers were recruited and controlled indirectly and on temporary basis by mistris or jamadars (Vaid, 1999). Similarly, in Bangalore city, the majority of workers in the construction industries are hired as 'piece-rate-workers' (i.e. casual), with immigrants accounting for 30-40 percent (Prayag, 2005).

The feature of immigrant skilled workers is also evident in the experience of Malaysia. The increase in the workforce engaged through subcontractors rose slightly from 71 percent in 1983 to 74 percent in 1998 (Abdul-Aziz, 2001); however, the migrant skilled workers rose from 40 percent in 1983 to 80 percent in 1992, (Abdul-Aziz, 2001). Employment in the formal sector of the construction industry in Kenya can be said to have stagnated at best, or declined. Conversely, there is increase in the informal sector in firms that employ from five to ten employees, (Wells, 1999; Njeri, 2001). The formal sector in South Africa employed over 400,000 in 1993, dropping to 254,000 in 1999. In the same period, employment in the informal sector rose to 243,000 in 1999 (Huyssteen, 2001).

The indications are clear that for a long time to come, the informal sector will continue to play a more active role in the construction industry. Though the terms and conditions of their operation may not encourage active participation in qualitative training of artisans on-site, yet if they adopt the principles of progressive implementation of construction process it will be possible to both improve the quality of the semi-skilled as well as train new artisans.

Training of Artisans On-site

Apprenticeship is one of the oldest methods of training artisans in construction skills. In earlier centuries, the practice included a five to eight years period of learning under a 'master craftsman' through an indenture (agreement). The industrial revolution and the economic burden on poor families reduced the popularity of this long period of apprenticeship (Schwartz, 1999). The common practice in the twenty-first century, especially, in the informal sector is the abridged form of 'on-site' training of artisans. The mode of operation, duration and intensity varies from place to place.

The practice in the Philippines in the early 1980s can be summarised as follows: There is no formal apprenticeship scheme in place, the independent foremen and Pakiao (subcontractor) conducts skill training for employees in their gangs; No definite duration, the trainees are often

relatives of the trainers, therefore no fee is charged; The principle adopted is that of 'learning by doing' with piecemeal briefings from the trainer, the trainee learns as much as the trainer knows and is willing to pass on to the trainee which is limited by the situations encountered in the project site(s) during the training period; Within the period of training, the trainee remains with one master craftsman; Three grades of artisans training are generally recognised but there is no definite structure for determining the boundaries of each grade; The foremen determine when a trainee is competent enough to graduate from any particular grade (Stretton, 1981).

The large firms are no longer making meaningful contributions to skills development in the industry, instead they are accused of pirating the artisans trained by the independent foremen (Stretton, 1998). However, a useful departure from the extremes of the independent foremen and the large firms is the role of the medium size construction companies. "They maintain a small permanent workforce consisting of skilled and semi-skilled artisans and other cadre of technical staff continually being developed" (Stretton, 1998:331).

In the 1980s, the practice of apprenticeship in the South Africa construction industry, was hinged on this principle "leerling Bouwplaatz", i.e. "Putting apprentice to work on a "real" building project so that they could benefit from building something that would last and yet still undergo on-the-job skills training" (BIFSA, 1986). The process was truncated in the 1990s with the exodus of many construction firms. The renewed efforts of the Master Builders Association of the Western Cape (MBAWC) Province of South Africa towards apprenticeship and general skills development involves structured apprenticeship training and skills development for those with some knowledge of the built environment trades; providing scholarships for engineering and construction related studies at both diploma and degree level and providing practical leadership training through mentorship programme (Lee, 2008).

The government of South Africa, responding to the decline in skills development in both the formal and informal sector, promulgated Act, No.97 in 1998 with the aims to develop and improve the skills of "South African Workforce". In April 2000, the Construction Education and Training Authority (CETA) was established to influence the course of training and skills development in the construction industry (CETA, 2008). A unique component of the role of CETA to the informal sector is the "Recognition of Prior Learning" (RPL) process. The process recognises artisans who acquired skills outside the traditional learning context, they are enrolled into a form of induction course to orient them and be certified in the appropriate grades, thus enabling them to function adequately in the construction industry (Fitchett, 2009).

The principle in practice in Namibia for training road builders and artisans has some unique features in terms of approach and funding; as summarised below:

- The training provider uses the "Production Method" where the accredited instructors provide on-the-job training in a way that combines the content of unit standard with the work necessary to meet contractual specifications
- The Road Authority contract documents make provision for an amount, being part of the contract value, to be made available, via the contractors' monthly payment certificates, for the training of road builders employed by the contractor (Keber and Thomas, 2007).

Generally, in both developed and developing countries, the large companies have off-loaded their commitment to skill development to an uncoordinated sector of the subcontractors. It is imperative therefore to harness the potential in this sector along with the medium size construction outfits for the development of skilled artisans.

Timbrel Vaulting

Due to the complexities associated with Vault construction using the “Timbrel” principle, such projects do not seem to be appropriate experimental projects for training artisans on-site, since it requires a ‘leap of faith’ for the uninitiated (Mallion, 2008). Records shows that during the construction of St John the Divine Cathedral in New York City, that span 132 feet (40m), the workers progressed at the rate of 18” each day, standing on the previous day’s work with nothing in front of them but 150’ drop, completing the work without incident in 15 weeks (Herald,1909). However, the uniqueness of the principle, simplicity in procedure, flexibility of substituting local material and the ease of comprehending the art are helping to revive this ancient art (Gould, 2008). Mastering the art of vault construction, like other masonry arches, supports the assertions of the adobe artisans of Egypt that: “If you understand the principles of the arch, you can build anything” (Viteri and Redabaugh, 2002). Vault construction is said to be a Mediterranean system by origin, developed and perfected in the Catalonia region of Spain where records can be traced back to the 15th century, exported to the USA in the 1880s by Rafael Guastavino (1842-1908), and was in use until 1940’s (Mallion, 2008). The timbrel vault is constructed with thin (light weight) material with limited use of formwork (Gould, 2008; Fitchett, 2009). The first layer is very important; it is set to the required curvature then the construction progresses simultaneously from all directions/corners in order to maintain equilibrium of forces (Fitchett, 2009). The first layer can be laid in either stretcher bond or herringbone pattern with strong adhesive (plaster of Paris) and subsequent layers laid to intersect the joints in the previous layers, preferable with cement or quicklime mortar (Gould, 2008; Fitchett, 2009).

For the construction of the Pines calyx conference centre and community building in Dover Kent, the team adopted the progressive principle of construction. The project consisted of two domes spanning 12m each, with a maximum rise of 1320mm. With the assistance of Michael Ramage from MIT, a mini dome, 3m span was built in May 2005 as sample and Training avenue for the contractor’s team .The first full size dome (12m span) was constructed under the supervision of Prof. John Ochsendorf and three Spanish masons. Then the technical staff and artisans from Ecolibrium Solutions Ltd, under the supervision of Sarah Pennell, built the second dome successfully (Mallion, 2008).

The procedure outlined above help to buttress the proposition of this paper that the skills and confidence of artisan (technical staff) can be improved upon/developed through progressive implementation of construction process starting from simple to complex areas.

Case Study 1: The Mapungubwe Interpretation Centre

The Mapungubwe National Park, under the South African National Park (SANPark), occupies the confluence of the three adjoining countries South Africa, Botswana and Zimbabwe. The mandate of the project team was to develop an Interpretation Centre for the Heritage site which should also benefit the host community. A collaboration between The School of Civil and Environmental Engineering, University of the Witwatersrand, Johannesburg, South Africa; Massachusetts Institute of Technology, Boston, USA, and the project team lead to the development of local material, ‘Stabilized Earth Tile’. A prototype of the vault was constructed under laboratory conditions, tested for suitability of material and the vault performed satisfactorily.

Training the Workforce

The ‘skilled’, semi-skilled and un-skilled workforce was recruited from the host community and up to a distance of 150km from the project site (Prinsloo, 2009). The training process started from the basics:

- Masons: were taught about mixing and placing mortar, preventing honey-comb in mortar beds, which lead to cracks and weakness in joints;
- Carpenters: were taken through the importance of correct measurements, cutting wood pieces to the correct size and shape, be they straight or curved patterns; the importance and use of hollow or solid form work, setting out correct geometrical shapes and adequate supports (formwork/scaffolds).

The training process was slow and tedious largely because of the low literacy level of the trainees and the attitudes of the local artisans who felt that the training was rudimentary which seemed to undermined their experiences coupled with language barriers that inhibited effective communication (Bellamy, 2009).



Figure 1 The learning and failure stage

Construction Process

Realising the complexities of Timbrel Vaulting and the skill level of the artisan, the project team secured the understanding of the client to start with the construction of the office units. The aims were to test the level of assimilation of training by the artisans and if the soffit of the finished product were not neat enough they could be remedied through plastering. The repeated failures experienced in this section made positive impact, reducing the pride of the artisan and there after they took every instruction seriously (Prinsloo, 2009; Bellamy, 2009). Those who were more experienced built the first layer bonded with plaster of Paris while the less experienced were given the task of building the subsequent layers with cement mortar (Fitchett, 2009).

The progress made in the experimentation on the office area encouraged the project team to commence work on the main project – the Interpretation Centre. Typical of timbrel vaulting, the solid formworks were used only at the entrance arches, strips of plywood sprung from each corner as profiles to guide the artisans. The construction progressed simultaneously from all directions in order to maintain equilibrium of forces. Contrary to the “150” void in front of the masons who worked on the vault of St John the Divine Cathedral, the common practice now is to erect platforms or scaffolds in the void in order to reduce the psychological stress on the workers as well as allow construction to progress from below and above the vault. The artisans progressed faster with confidence making fewer mistakes but still under strict supervision, and the seemingly complex project was completed successfully.



Figure 2 Corrections taken, construction progressed in different sections



Figure 3 Showing part of the completed Mapungubwe Interpretation Centre

Case Study 2: Developing Private Parks/Game Reserves

Under the South African National Park (SANPark) many of the abandoned private farms/game reserve in South Africa are being operated on the platform of Public Private Partnership with private tourist organisations like 'Conservation Corporation Africa and Wilderness Safari' (Silvio, 2009). The developers are also to adopt the government's policy of benefiting the host community and skill development for employability. The unique approach of 'Conservation Corporation Africa' and their project Architect 'Adventure Architecture' is to adopt a design philosophy that promotes:

- Conservation of nature in the settings of each project.
- The use of typical African(local) features or material in the construction
- Improving existing skills or and transfer of skills and
- Benefiting the host community.

In each project, a search is made within the host community to identify persons knowledgeable in any related trades needed for the execution of the proposed project. They are given orientation and guided in the application of the skills in different ways to execute the project at hand. The unskilled labourers discovered with potentials to learn a trade are encouraged and paired with artisans in the particular trade of interest, in what may look like an informal apprenticeship. In the event that no artisan is found within the community knowledgeable in a particular trade, a type of 'master craftsmen' is brought into the project to train some local prospects on the site (Silvio, 2009). This practice is consistent with Fathy's approach to training to mitigate the cost and long duration of apprenticeship, where master-craftsmen were brought in from elsewhere in Egypt on a 'contract' system for short duration. By not staying long-term they would pass on their skills quickly (Fathy, 1976).



Figure 4 Construction from dream

The construction process usually progress from simple areas requiring minimal skill level to complex (finishing) areas that requires high skills levels. The artisans are guided continuously in order to improve their skills gradually as the project progress through the different stages. At the end of each project the artisans with previous knowledge in the trade have improved their skills and can adapt it under different situations, while others have learned enough in their respective trades to make them employable in future. Initially investors were apprehensive of this approach; however, their prejudices gradually disappear as the project evolved from stage to stage (Silvio, 2009). The finished product has continued to be a tourist delight as it enables visitors to identify with the blend of natural setting in contemporary facilities. Some of the projects have won international awards.



Figure 5 The finished product

Findings

The two projects investigated adopted the principle of progressive implementation of construction processes as a means of training artisans on-site, using different approaches but achieved similar results. Some of the key findings include:

- The skills of the artisans improved progressively as the construction progressed from simple to complex stages;
- Successful completion of prototype created the necessary encouragement in the workforce, reinforcing their confidence and ability to apply their knowledge appropriately in the later more complex stages of the project;
- Though the new trainees may not be proficient in their respective trades, yet they possess skill for improved employment;
- The success recorded in these training experiments were possible because of the active participation of the project personnel- client, consultants and contractors;
- In the Mapungubwe project, the collaboration with the academia gave vent to the application of relevant research findings.

The above findings are consistent with observations in literature. The technical team responsible for the development of the Pines calyx conference centre and community building in Dover Kent learnt the art of “Dome” construction first by observation and then by participation along with experts before they executed the actual construction (Gould, 2008; Mallion, 2008). Gann and Senker (1998) advocate two types of partnering in the built environment industry that could foster skills development. Firstly, “firms... developing long-term partnering with clients for successive projects or maintenance services” (Gann and Senker, 1998: 572), this will provide continuity of work and learning opportunities for the trainees. Secondly, partnering between organisations to “create a climate of cooperation and problem-solving...identifying skill needs which require specific training...” (Gann and Senker, 1998: 572). The Skills Development Act (SDA) enacted by South Africa government requires that employers should “provide formal structure education and training to their workers” (Haupt and Chileshe, 2008). If these objectives

are to be achieved, the government of South Africa need to complement the Act with adequate patronage of the construction industry.

Conclusion

The concept of executing construction projects from simple to complex areas as a tool for training artisans on-site in the construction industry provides a potential solution to the dearth of skilled artisan in the industry. The case studies sighted in this paper clearly demonstrates that the approach is viable. This principle has been tested in few isolated projects; it can be used to execute the development of small public infrastructures like classroom buildings, primary health facilities, police stations, sanitary systems, especially in the rural areas. The designs can be repeated many times with minor alterations to reflect the specific locations (Fathy, 1976). The benefits include contractor's development, skills acquisition, retaining large sum of project cost within the host community, poverty alleviation and mitigating rural-urban drift.

Recommendations

Realising the concern of every stake holder in the construction industry towards skills development, further research should be conducted on developing framework for identifying medium size organisation (consulting/construction) with capacity for training to be harnessed and used for coordinated training. Such framework could provide incentives such as preferential procurement policy to ensure continuity of business and active involvement in continuous training of artisans, directly or through mentoring of operatives in the informal sector.

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