



## Strategies for the Revitalization of Civil Engineering Education in Nigeria – An Overview of Vitruvius Ten Book on Architecture

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### Abstract

*There concerns being raised on the competence of engineers, including civil engineers. This concerns is giving impression that civil engineering is not yet able to serve as driver of the nation's economy as it is in the advanced nation. This paper gives a possible insight on the perspective from which it should be addressed; with reference to historical Roman civil engineering, especially Caesar's Rome. The approved curriculum for the training of civil engineers, using Vitruvius's Ten Books on Architecture, as approved by Caesar, was used as the main source of information. In addition, the information available in the public domain like the internet resources, libraries, and books; civil engineering education and practices, were used as supplementary materials and sources of additional data. Some findings from this discourse are that the Nigerian definition of civil engineering is inadequate in depth and scope. Also obvious is the fact that varied and diverse but coordinated wisdom is required for the practice of civil engineering. Further, the study showed that absence of honest and incorruptible ethics may stagnate civil engineering profession in Nigeria. It is thus concluded that ICE definitions of civil engineering should be used as a guide to frame words and expressions for a concise Nigerian definition of civil engineering. This is with the aim of revitalization of civil engineering training and practice in Nigeria, by positioning it on the solid foundation that is necessary for continuous development.*

**Keywords:** Civil engineering, Education, Equipment, Ethics, Revitalization.

### 1.0 Introduction

Notwithstanding the misgivings or otherwise, Nigeria came into being as a nation, thus under the guardianship of the United Kingdom (UK) around 1914 when the then Southern and Northern protectorates were amalgamated and given the name Nigeria [1,2,3]. Through the guardianship of the UK, all the accumulated ancient European developmental resources, which were rooted in the ancient civilization of imperial Rome began to flow into the young Nigeria nation. One of these resources are educational in nature. Engineering education was some of the developmental educational resources that came into Nigeria through the UK. This is not however without prejudice to the existence of engineering crafts and trade activities at different locations in these territories [4,5,6], but they were without means of dissemination, or transmission, or institutional establishment. Not only that, records and documents containing the theories and principles on which served as the guiding light for the practice of engineering in a civilized and ordered society were missing. Thus, engineering education came through the institutions created in Nigeria under guardianship of UK. This started with the establishment of Yaba Technical College in 1932, followed by engineering faculties in UNN (1960), UI (1962 as autonomous University), ABU (1962) and IFE now OAU (1962), all under the UK imperial educational institutions, despite the fact of Nigeria independence in 1960. Since that time however, many Universities and Polytechnics offering engineering courses have been established. The curriculum of these institutions was all modelled after the systems of the UK. Civil engineering in particular, enjoyed the privilege of being the earliest form of engineering education established in Nigeria, that is, at the Yaba Technical College. According to [7], at the Yaba Technical College, engineering was taught by an engineer seconded from PWD and a building instructor. However, in recent times, quality of engineering graduates from universities and polytechnics in Nigeria has been a major concern because it yet to measured up to the standard in Europe [8, 9]. There is this general opinion now that the standard of engineering education in Nigeria is yet to reach the stage where it can serve as driver of the Nigeria socio-economic development [9, 10, 11, and 12]. This, of course, was not exempting civil engineering, on which this paper is centred. That is why, it is necessary at this point, to understand what constitutes civil engineering, so as to establish a common standard as the basis for quality judgment. In 1828, Thomas Telford, a member of the Royal Societies of London and Edinburg and others, obtained the charter that established the Institution of Civil Engineers of the UK [13]. The charter is still the one in use till date, and by extension, still operating in Nigeria. Excerpts from that charter that incorporated the civil engineering profession into body politic and corporate, is reproduced below for our discussion.

“ . . . . . Thomas Telford, of Abingdon Street, in the City of Westminster, Esquire, a fellow of the Royal Societies of London and Edinburgh, and others, had formed themselves into a Society for the general advancement of Mechanical Science, and more particularly for promoting the acquisition of that species of knowledge which constitutes the profession of a Civil Engineer, *being the art of directing the great sources of power in Nature for the use and convenience of man, as the means of production and of traffic in states both for external and internal trade, as applied in the construction of roads, bridges, aqueducts, canals, river navigation and docks, for internal intercourse and exchange, and in the construction of ports, harbours, moles, breakwaters and lighthouses, and in the art of navigation by artificial power for the purposes of commerce, and in the construction and adaptation of machinery, and in the drainage of cities and towns . . .*”:

Despite the revisions of the Charter by ICE (2015, 2018 and 2022), the wordings of the definition was retained as it was, in the original Charter of 1828. Two sections can be observed from this excerpt. They are the identity of the promoters of civil engineering and the definition of civil engineering itself. That the promoters of the profession of civil engineering were royals, speaks volumes, but that is left for another date. However, studying the wording in the definition of civil engineering, judging from the amount of information that is in the public domain, the thought being conveyed were massive in length, width, height and depth. For brief analysis, the definition includes concepts, which on their own, could stand alone, yet integrated together as one. Such concepts were:

- i. Forces of Nature
- ii. Convenience of Man
- iii. Means of production
- iv. Traffic in States, both for external and internal trade
- v. Construction of roads, bridges, aqueducts, canals, river navigations, docks, etc
- vi. Internal intercourse and exchange
- vii. Construction of harbours, moles, backwaters, lighthouses
- viii. Construction and adaptation of machinery
- ix. Drainage of cities and towns

It can be deduced that the profession is at least, “state profession”, or even, practically speaking, extending beyond the boundary of any state, in so far as the word “nature” encompasses all states. Similarly, man means humanity without any distinction, as most of the items in the definition. Historically, Britain was one of the 43 provinces under the administration of the Roman Caesar’s peace, and she was under direct military and non-military administration of the Emperor himself, up to 410 A.D [14] (Milliken, 1958). The fact that the promoters of civil engineering (in 1828 A. D.) were royals, suggested a link to over 2000 years of accumulated royal resources of ancient Roman empire. That is, from the period of Kings (753 – 510 B. C.), to the republican Rome (509 B. C. to 27 B. C.); and finally, to the Caesar’s imperial Rome that began as from 27 B. C. onwards that ushered in Roman peace. Furthermore, [14] Milliken (1958) stated that apart from building of many towns (including London), construction of military roads and surveying works that were undertaken by the Romans, they also ensured that Latin language and education were firmly established in Britain. Thus, the Roman background of the proponents of civil engineering as a profession in 1828 was unmistakable. That is why the evaluation of civil engineering, ought to be done in relation to its original conception taking cognisance of certain fundamental foundational requirements that are needed for sustainable civil engineering practice from generation to generation. The definitions can be dissected from many angles depending on circumstances and the experience gained so far. For this paper, these requirements can be categorized into three, namely (i) the education needed, (ii) the equipment requirements and (iii) the ethical attributes of engineering personnel. The aim of this work is to look at these three fundamentals with the purpose of determining to what extent the civil engineering profession in Nigeria has measured up to them and also to determine whether the whole national civil engineering curriculum is rightly directed.

## 2.0 Methodology

Since the content of this paper was based on the treatise by Vitruvius “Ten Books on Architecture”, translated from Latin into English language by [15] Cambridge University in 1914; most of the information in this paper was derived from the book. Peer-reviewed journal articles and relevant scholarly publications built around “Ten Books on Architecture” were examined. Other scholarly works that are available in the public domain like internet, Universities Repository and Libraries, Books, and so on, that were found to be relevant were used as supporting document. In addition, dictionary and books for gaining understanding, in the classical languages of Latin and Greek were also consulted to provide illumination, with a view to providing understanding into the usage of some words in the Book.

### 3.0 Results and Discussion

Analysis of “Ten Books on Architecture” together with additional data from other named sources in the Methodology were carried out. The author was guided by the desire to uncover what made the Civil engineering practices, that existed over 2000 years ago, the guiding principles in educational institution and in general practice in the present times. The presentation the results of the analysis, has been divided into three subsections, namely: (i) required education, (ii) required equipment, and (iii) ethical imperatives expected. The results of the analysis are presented as follows.

#### 3.1 Education needed for Civil engineering Practice

In determining the education needed, the author looks at the educational background of the promoters of civil engineering. The Roman roots of the promoters of civil engineering was established in the “Introduction”. It is necessary then, to get an insight into the curriculum of civil engineers in Rome that formed the basis of ICE definition of civil engineering. A man named Vitruvius, Caesar’s military engineer, who wrote between the period 58 B. C. to 10 A. D., documented the construction training and practices of the Romans in his “Ten Books on Architecture”, translated from Latin into English language by [15] Cambridge University in 1914. In the period, architecture and civil engineering were used interchangeably. From two Greek word “*arche*” (meaning imperial/prince) and “*tekon*” (meaning to build); the word architecture was formed to mean builder of all type of structures including houses of all types, bridges, roads, water-ways, drainages, towers, construction equipment, etc. Civil engineering on the order hand means citizenship engineering; civil being from the Latin word *civile*. It is here that construction or building of military machines, engines, etc. came into the picture. In the time, military was part of citizenship functions. The use of civil engineer and architecture interchangeably was to convey the thought that it requires an *ingenium* (engineer) citizen to be able to build an enduring foundation that is the hallmark of an *archetekon* (imperial-builder) [16]. According to Vitruvius [15], the foundational categories of education and training required for a virile civil engineering practice is itemized, with stated reasons, in Table 1.

Table 1: Breakdown of the curriculum of Vitruvius’s Civil Engineer

| Knowledge Required |                                | Relevance to the Profession |                                                                                                                                            |
|--------------------|--------------------------------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1                  | Skillfulness with pencil       | a)                          | Necessary to be able to sketch the appearances of work being proposed                                                                      |
| 2                  | Knowledge of Geometry          | a)                          | Teaches the use of ruler and compass required for making plans of buildings on the ground.                                                 |
|                    |                                | b)                          | Enable the right application of square, the level and the plummet                                                                          |
|                    |                                | c)                          | The Optics in Geometry enable light to the building to be drawn from fixed quarters of Heaven                                              |
|                    |                                | d)                          | Arithmetical part of geometry enables the cost of the building to be calculated and measurement to be computed                             |
|                    |                                | e)                          | Geometrical theories and methods allow symmetrical problems to be solved                                                                   |
| 3                  | Knowledge of Political History | a)                          | Necessary to be able to preserve or repair the society                                                                                     |
| 4                  | Knowledge of Philosophy        | a)                          | To make the Civil Engineer not to be self-assuming, but make him courteous, just, honest and without avariciousness.                       |
|                    |                                | b)                          | Civil Engineers have to be honest and incorruptible.                                                                                       |
|                    |                                | c)                          | To learn Physics and its fundamentals, which is taught under Philosophy so as to be able handle numerous construction works                |
| 5                  | Knowledge of Music             | a)                          | To give knowledge of canonical and mathematical theory                                                                                     |
|                    |                                | b)                          | To be able to tune ballistae, catapult and scorpions to proper key                                                                         |
|                    |                                | c)                          | To be able to make water organs and objects which resemble them                                                                            |
| 6                  | Knowledge of Medicine          | a)                          | To settle the issues of climate, air, healthiness or otherwise of sites and the use of different waters to ensure healthiness of dwellings |
| 7                  | Know opinion of Jurists        | a)                          | So that in drawing up contracts, interests of both the employer and contractor are safely guarded.                                         |
|                    |                                | b)                          | For the understanding of laws governing some elements of building, for example, drains, windows, water supplies, etc.                      |
| 8                  | Knowledge of Astronomy         | a)                          | To locate East, West, South and North                                                                                                      |
|                    |                                | b)                          | Knowledge of Constellations and Stars                                                                                                      |
| 9                  | Theory of Heavens              | a)                          | To locate equinox, solstice, course of stars and revolution of the firmament                                                               |
|                    |                                | b)                          | To be able to comprehend the Theory of Heavens                                                                                             |
|                    |                                | c)                          | To be able to construct machines                                                                                                           |

Careful analysis of the details of curriculum content of Table 1, with reference to the massive amount of information that is available in the public domain, will show that the goals of civil engineering, as defined in the charted of ICE [13, 17, 18], was set against the background of the curriculum recommended by Vitruvius in Table 1. For example, the expression “the power of nature” was an expression used by Vitruvius in Chapter nine of the Book in the section on “the Zodiac and the Planets” Book. The word “nature” in the definition encompasses the whole universe, including rivers, seas, stars and heavenly bodies, which are given ample mentioning in items 2, 8 and 9 of Table 1. Vitruvius [15] conceived the universe as the assemblage of natures. Adequate background in these will definitely equip the civil engineers for the navigational issues, construction of harbours, moles, backwaters, and lighthouses that were contained in the definition of civil engineering [13, 17, 18]. Furthermore, the term “the convenience of Man” can also be understood to mean for the good of man”, was a fundamental preoccupation of the philosophers as to what constitute “*summum bonum*”, that is, the common good for man. Philosophical issues to drive the curriculum was dealt with in item 4 in Table 1. Also, the construction and adaptation of machinery in the definition was taking care of in item 5 of Table 1. In the same vein, drainage issues of cities and towns appeared under item 7 in Table 1. Careful analysis of items in Table 1 in minute details, if re-arranged to conform to the modern categorization, will show that the achievement of what constituted civil engineering, according to ICE [13, 17, 18], is possible by going through the curriculum described in Table 1. The substance of that curriculum, now bifurcated into different branches and given varieties of names has not changed. Hence the words used in the definition of civil engineering in 1828 was repeated word for word by later revisions ICE [13, 17, 18]. Here conformity to the Roman educational training and systems was in view, even in this our times. Taking the definition of civil engineering and the curriculum summarised briefly in Table 1, it is clear that the three main parts of a curriculum; in purpose, content and organization of learning are satisfied [19]. In Nigeria, the typical contents of the undergraduate curriculum of civil engineering program in a typical Nigeria Universities that serve as the foundation for civil engineering practice in Nigeria is presented in Table 2 [20].

Table 2: Typical Contents of the Curriculum for BEng. Degree in Civil Engineering in Nigeria

| Curriculum        | Contents                                                                                                                                  | %   |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----|
| General Studies   | English language, History,                                                                                                                | 8%  |
| Basic Sciences    | Mathematics, Physics, Chemistry, Computer appreciation, Drawings,                                                                         | 15% |
| Basic Engineering | Computer appreciation, Introduction to Computer programming, Drawings,                                                                    | 24% |
| Core Courses      | Mechanics, Strength of materials, Engineering materials, Surveying<br>Highways, Transportation, Geotechnics, Structures, Water Resources, | 44% |
| Electives         | Hydraulics, Environmental Engineering<br>At the discretion of the students. Usually Departmental electives                                | 3%  |
| SIWES             | This is Students Industrial Work Experience Scheme (SIWES)                                                                                | 6%  |

The curriculum content in Table 2 are the requirement for national accreditation of the civil engineering program in Nigerian Universities. The equivalent of Britain Institution of Civil Engineers (ICE) is the Nigerian Institution of Civil Engineers [21]. The Nigerian Institution of Civil Engineers [21] defines civil engineering as:

“... a professional practice that applies the knowledge of mathematics and the physical sciences to design, construct and maintain the physical and naturally built environment for the benefit of man and the environment...”

The NICE [21] definition avoided the ICE [13, 17, 18] definition, and used the words that were similar to American definition, but in a very incomplete form. The American Society of Civil Engineers [22] defined civil engineering as:

“... the profession in which a knowledge of the mathematical and physical sciences gained by study, experience, and practice is applied with judgment to develop ways to utilize, economically, the materials and *forces of nature* for the progressive well-being of humanity in creating, improving and protecting the environment, in providing facilities for community living, industry and transportation, and in providing structures for the use of humanity. . . .”

However, the similarity in content of ASCE [22] to items in Table 1 and ICE [13, 17, 18] definition was obvious, though the wordings were more modern. The Nigeria version fell short of the standard. Thus, using the NICE [21] definition in Nigeria may not lead to the type of development that will make Nigerian civil engineers stand on their feet, and raise their heads even in Nigeria environment, not to talk of making them perform at the global level because it is limited in scope and depth. Since British standards are used in Nigeria tertiary institutions for instructions in civil engineering, it is reasonable to adopt the ICE [13, 17, 18] definition, and see to what extent the curriculum in Table 2 tends towards Roman training as articulated by Vitruvius [15] which was the foundation on which ICE [13, 17, 18] rested. Although the curriculum content in Table 2 included general studies and basic

sciences, they are likely unable to measure up to the standard that will enable the attainment of the goals set in the definition of civil engineering. This is because of seeming disconnect from foundational educational issues of engineering which is rooted in the classical Greek philosophy. Vitruvius [15] said that physics, and by extension, the sciences should be taught from philosophy. Justice, honesty and incorruptibility issues formed the basis of sciences and they are domiciled in philosophy. The absence of these virtues in the training of civil engineering makes civil engineering practice impotent because, no work can be done without honesty and incorruptibility [15]. This thought pattern is strange in Nigeria, thereby uncovering a fundamental deficiency in the curriculum that explains some of the reasons for the seeming stunted growth in civil engineering practise in Nigeria. Also, it is true that English language formed part of the curriculum. But English language learnt for the purpose of communication will not be sufficient for sound civil engineering practice. Other professions including those without formal education or University education also learn and speak as well as write English language fluently. There is the English language that is peculiar to engineering that serves as medium of conveyance of civil engineering resources. These resources were providentially preserved in Latin, on which English language was founded. Available information in the public domain unmistakably showed that institutional civil engineering profession had Roman roots [23, 24, 25, 26]. To civil engineers, Latin language was the working language of civil engineering, not just communication language because it held the treasures of civil engineering creativity and ingenuity. Thus, the study of English language without connection to its Latin roots, is like depriving the civil engineering education and practice its nourishment and life support systems. Similarly, history is the political history or citizenship history. In fact, civil engineering is synonymous to citizenship engineering. The Romans, in their actions and words, believed they belong to the State and her Gods first before any identity. Just like the modern day American, or any of the European nations. It was believed that the problems of the society are solved through the state. If engineers, including civil engineers want to solve the problem of their society [27], how can they solve those problems without the knowledge of their society – the histories, the traditions, the customs, the ethics, etc.? How can they solve the citizens' problems with the issue of the citizenship yet to be resolved? This is what training in history was meant to accomplish. Unfortunately, Nigerians do not see themselves as Nigerians first, but as either Yoruba, or Hausa, or Igbo, etc. or in some cases Muslims or Christians. Nigeria is yet to reach that concept of citizenship as encapsulated by the philosophers that formed the bedrock of Roman citizenship out of which sprung the modern-day British, American, European nation's citizenship concept. Neither do Nigerian engineers see engineering in a developmental sense but rather as another occupation for making money [28]. Making-money will not create the environment to nurture engineering [29]. The non-development of this concept and non-embedding in the curriculum hampers engineering development in Nigeria. There are some topics in Table 1 that look very strange to Nigeria audience, but were included as part of civil engineering education. These are: knowledge of music, knowledge of medicine, knowledge of the opinion of Jurists (Priests<sup>1</sup> concerned with absolute and eternal values, that are valid for all men at all times and in all places), and knowledge of astronomy. Also, the classification may seem unfamiliar at first glance. Further perusal of the details of the courses will uncover familiar subject but with different title.

It is glaring that the curriculum of civil engineering in Nigeria have yet to see the relevance of these; and thus, lacked inputs from these domains of human endeavour, and this needs to be taking care of, by the stakeholders for robust, dynamic and sustainable civil engineering practice for the next generation

### 3.2 Equipment needed for application/implementation of Civil engineering education

The ICE [13, 17, and 18] definition of civil engineering seemed to assume that the knowledge of mechanical science was foundational to the training and practise of civil engineering. The art of directing the great power of Nature that formed the bedrock of civil engineering definition by ICE [13, 17, and 18] required the necessary tools and equipment for that task. These tools are mechanical, necessitating the knowledge of mechanical science. The preface to the definition of civil engineering include the phrase "*general advancement of Mechanical Science*", and another phrase towards the end contained "*the construction and adaptation of machinery*". This clearly implied that civil engineering and mechanical science are inseparable if the forces of nature must be directed to serve mankind and construction of civil work accomplished. By looking at the sketchy details of the curriculum content by Vitruvius [15] in Table 1, it is obvious that the personalities behind ICE (1828) took some lessons from it while defining civil engineering; and thus expect succeeding engineers to follow suit to be able advance it further through lessons on it. This is where importance of items 8 and 9 in Table 1 became evident. This is the aspect that deals with the understanding of the natures (or the universe) as necessary condition for the construction and adaptation of equipment to direct and harness them for the use of mankind. According to Vitruvius [15]

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<sup>1</sup> Barrow (1953)

“... all machinery is derived from nature , . . and founded on the teaching and instruction of the revolution of the firmament. Ancestors took models from nature and imitated them”.

This is in agreement with Barrow [30] that Romans were under Stoic philosophical school of thought that man should live according to nature in relation to the larger reason which animated the world as a whole. Vitruvius [15] described many principles governing the manufacture of many types of machines and engines in chapters 9 and 10 of his book, “Ten Books on Architecture” relating heavens, stars and other heavenly bodies to the making of machines, equipment and engines. It was obvious from the book that Vitruvius was a master in the art of making of construction machines, equipment and engines and that he indeed employed them for all the numerous constructions works – military and non-military, he undertook for Emperor Caesar Augustus mentioned in his 1967 translation of his deeds written around 10 A. D. [31] and also mentioned in several places by Vitruvius himself in the book [15]. The NICE [21] definition of civil engineering also failed to capture this fundamental requirement of civil engineering practice. This is the reason why this ability is wanting in Nigerian civil engineers because the curriculum failed to recognize this. Recognition of the relationship between the forces of nature and the ability to develop as well as construct of equipment would have served as stimulus for deep exploration of nature. That might be one of the reasons why the civil engineering construction space in Nigeria is dominated by foreigners.

### 3.3 The Ethical requirement of Civil engineering personnel

The importance of honest and incorruptible ethics as condition for civil engineering practice was given by Vitruvius [15] as can be seen in Table 1. This is because of the fact that engineering, as something that engineers do, and what they do, has profound effects on others [32]. Not only that, engineers make decisions that will impact society, either positively or negatively. Thus, all engineering decisions involve ethical considerations and situations which are not addressed in formal technical calculations [33]. It is within this context that the acquisition of ethical knowledge and skills required to make decisions that limit harm to society should be considered to be of paramount importance in civil engineering. In civil engineering in particular, consequence of corrupt and dishonest ethical behaviour is costly to the society in terms of loss of lives from failure of civil infrastructures like buildings, roads, bridges, etc., poor health resulting from drinking water that was not treated as specified, wastes of resources, environmental pollution, disruption of public economic activities in the vicinity of failed and dysfunctional public infrastructure, etc. All these cannot be hidden from the public view; hence society demands honest and incorruptible civil engineering practice. It is however important to understand what constitute honest and incorruptible ethics for civil engineering practice before we begin to think of how to acquire and sustain it. However, what constitutes ethics differ from nation to nation. For example, North American concept of ethics, as defined by engineering educators, is different from their European counterparts [24]. Other differences may be expected across the globe. Thus, there are so many angles to the ethical issues of civil engineering, which are but fragment of the whole. Since, the profession of civil engineering had Roman roots, it is necessary to look at ethics from the perspective of the documented ethics of the genius of the Roman people that seemed to drive their civilization in which civil engineering construction remain the enduring character of lasting expression of the civilization [25]. According to Barrow [14, 30], these elements that formed this ethic were described in some Latin words. These words together with their description are presented in Table 3. Milliken [14] concluded that the results of the practice of these qualities enabled the Romans to develop systems, including ingenious civil engineering construction, that are still in use to the present time. The objective of this paper is not to discuss these ethical citizenship attributes, as each of them relate to civil engineering, as that would amount to a very difficult, if not impossible task for one person, for the task that is corporate or national in nature, but rather, to identify a guide for a need that should be addressed. Some Universities have seen the need for it, and have started some innovative measures to address this in their curriculum [33, 34, 35]. This is in obvious realization of the words of Mitcham [24] and ABET [36] that:

“... an understanding of the ethical, social, economic, and safety consideration in engineering practice is essential for a successful engineering career. Course work may be provided for this purpose, but as a minimum it should be the responsibility of the engineering faculty to infuse professional concepts into all engineering course work. ...”

Table 3: The elements of Roman ethics

| Quality |        | Description                                                                                                                                                                                                                                                                                                                      |
|---------|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1       | Pietas | This is for eternal values, the will of the Gods which ruled the World and their expression as objective right in the practical things of human life. The proper submission to all the established institutions, and a sense of duty to the immortal Gods and one's parents, that is, the habit of obedience to divine authority |

|    |             |                                                                                                                                                                                                                                                                                                                                                                                    |
|----|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2  | Simplicitas | The quality of the man who sees things clearly and see them as they are, that is, keeping one's feet planted firmly on the ground                                                                                                                                                                                                                                                  |
| 3  | Frugalitas  | Simple tastes                                                                                                                                                                                                                                                                                                                                                                      |
| 4  | Gravitas    | Serious sense of responsibility which made even the smallest affairs of life seem too great to be trifled with                                                                                                                                                                                                                                                                     |
| 5  | Humanitas   | Respect for human personality and relationship. A sense of the dignity of one's own human personality, which is unique and which must be cared for and developed to the full; and the recognition of the personality of others and their right to care for their own personalities; and this recognition implies self-restraint. Respect for human personalities and relationships |
| 6  | Virtus      | Manliness and energy                                                                                                                                                                                                                                                                                                                                                               |
| 7  | Disciplina  | The training (at home and public) which produces steadiness of character                                                                                                                                                                                                                                                                                                           |
| 8  | Industria   | Hard work                                                                                                                                                                                                                                                                                                                                                                          |
| 9  | Constantia  | Firmness of purpose. Tenacity of purpose                                                                                                                                                                                                                                                                                                                                           |
| 10 | Clementia   | The willingness to forgo one's rights for common goals                                                                                                                                                                                                                                                                                                                             |
| 11 | Comitas     | Good humour                                                                                                                                                                                                                                                                                                                                                                        |
| 12 | Libertas    | Maintenance of freedom of individuals                                                                                                                                                                                                                                                                                                                                              |
| 13 | Fidas       | Respect for pledge words and the expressed intention                                                                                                                                                                                                                                                                                                                               |
| 14 | Mores       | Respect for tradition. Holding fast to what has been handed down as containing accumulated wisdom, which no moment or man can supply                                                                                                                                                                                                                                               |

## 4.0 Conclusions and Recommendations

### 4.1 Conclusions

From the above discussions, the followings conclusions can be drawn. The Nigerian definition of civil engineering is inadequate in depth and scope. Also, it is concluded that varied and diverse wisdom, integrated and anchored on the concept of citizenship, are required for the practice of civil engineering. Furthermore, absence of honest and incorruptible ethics may stagnate civil engineering profession in Nigeria.

### 4.2 Recommendation

It is glaring that the definition of civil engineering fell short of the standard definitions of developed nations, especially that of ICE [13, 17, 18]; and neither did the curriculum have sufficient foundation in philosophy, jurisprudence, and others identified in this work, from which robust and dynamic practices can be built from generation to generation. The stakeholders in the profession should use [13, 17, 18] definition as a guide to frame a new definition of civil engineering, which will be used to identify the content of the new curriculum, and the arrangement of such contents from, may be, primary school to university level. Going to the root of civil engineering to map out a new curriculum of civil engineering in Nigeria is necessary so as not to remain as a child, according to the conclusion drawn by Cicero [37], that to know nothing of what happened before you were born, is to remain forever a child.

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