Site Engineer -Imbibing ethics & best practices in job execution to forestall errors leading to Structural failures.

Introduction.

The built environment has been kept vibrant lately -thanks to the private developers who have invaded our space, albeit for profit reasons in most instances; little wonders buildings are falling left right and center as some of our colleagues who ought to put them in check are more concerned with securing their daily bread than uphold the ethics of the profession.

For discussion and clarity, let us adopt these two appellations:

1. Design engineer
2. Site Engineer

Design Engineer

He is responsible for the design and overall stability of the building. All working documents emanate from his office and duly checked for compliance with the building code provisions and requirements.

The building codes of practice could be construed as a compilation of agreements reached by stake holders in the industry to govern and ensure safety during project execution and beyond.

Projects are construed and executed via the British Standard Institution codes of practices in this clime.
Institutions, and organizations responsible for the preparation of BS 8110-1 for instance are listed below:

Association of Consulting Engineers
British Cement Association
British Precast Concrete Federation Ltd.
Concrete Society
Department of the Environment (Building Research Establishment)
Department of the Environment (Property and Buildings Directorate)
Department of Transport (Highways Agency)
Federration of Civil Engineering Contractors
Institution of Civil Engineers
Institution of Structural Engineers
Steel Reinforcement Commission

You can understand now why your consultant Structural engineer would frown at haphazard modifications to the works owing to departure from his design provisions,

what you have done -rightly put, is that you contravened established rules and procedures, in a daring manner.

Site Engineer

His responsibilities along the line of our discussion are hereunder listed:

1. Study and appraise all issued documents that are marked for construction purposes and ascertain conformance with ones issued by others -i.e., Architectural and building services. Where conflicts are observed, escalate promptly for rectification.
2. Pay particular attention to unusual details and seek clarifications for clarity.
3. Perfect concrete mix designs and ascertain adequacy via trial cubes -mean of three samples crushed at 7 and 28 days respectively.
4. Carry out and obtain tensile steel yield test results on reinforcement steel samples to be deployed to the works.
5. Submit results of tests executed in 3 and 4 to design engineer for approval prior to work execution.

Compliance with drawing provisions alongside deployment of appropriate rebar shapes and type is the perfect handshake between design and site execution. Problem arises when site engineers begin to deploy preferred bar shapes and cuttings -which often runs fowl of acceptable lap and bond lengths, thus translating to higher cost overruns in time and material.

Other areas of concern wherein ethics and best practices are mandatory are hereunder stated:

Design philosophy

Design philosophy often does not get served with documents meant for work execution. Hence, the need to query “off the regular” detailing styles -at Column / beam intersections, r.c columns starter bars / main rebar laps, purpose placed chairs at perimeter around column heads in flat slabs, etc.
An intricate study of working documents prior to commencement of works on site is highly recommended.

Explanations should be sought on grey areas from the design engineers for proper understanding.
Indeed, *it is foolhardy building what you do not understand*.

Concrete cover

Concrete covers to steel reinforcement are required for protection of reinforcement from corrosion and fire. Section 3.3 of BS 8110-1 deals extensively with requirements for thickness and circumstances requiring such.

Interestingly, it is not as if this requirement is difficult to achieve, personnel on site often completely leave quantity and size (at times), to the wishful desires of laborers.

It is crucial that appropriate quantities are deployed to the entire perimeter of rebars and centralizing of reinforcement steel assured.

Lack of adequate attention to this requirement is responsible for the early rupture of reinforced concrete by spalling.

A situation wherein tradesmen are left to cut, bend, and arrange steel reinforcement as they like, has contributed greatly to premature attainment of building End of Life. Instances abound where beam elements experiencing torsion were wrongly provided with regular shape code 61 links and 25mm cover instead of shape code 79 with 50mm cover.

Rebar works.

Aside the foreign companies, rebar works amongst indigenous contractors are often cut straight, paying more attention to reducing off-cuts and waste at the expense of safety.

Rebars are to be cut and bent as par provisions in bending schedule pages. A lot of lap issues would naturally be done away with if bars are cut and bent as required; likewise, minimum spacing between bars would be maintained at the greater of maximum aggregate size+5mm or largest bar size.
Once spacing between adjacent bars falls short of this requirement, bond issues between reinforcement steels and concrete would result in undermining the elements performance.

The crank in links -shape code 61, is often wrongly finished 90 degrees as opposed to the 135 degrees expected. The former would aid buckling failure in columns.

Handing over steel works in its entirety to the iron benders is unacceptable, even though this practice is quite prevalent on most sites lately. The appropriate thing to do would be to have the site engineer sketch component bars with all dimensions fully annotated. Each sample is to be reviewed by the engineer and judged satisfactory or otherwise prior to executing the works fully.

Form work:

Formworks are to be completed leak-proof and top-level ascertained tabletop flat prior to carrying on with further works.
Indiscriminate perforations are to be avoided and wherever such are required, they are to be properly planned and cut out with ample care taken to forestall loss of slurry while casting concrete.

The usual practice of having services contractors run wild on site by punching holes wherever convenient is never to be permitted. This is the point at which the leadership

quality and human relation capabilities of the site engineer are being tested and perhaps stretched to the limit.
What I have seen work is friendly engagement and soft (yet persistent) nudging in good time well ahead of work execution.

It is in the interest of the main contractor that site engineers are in copy of detail services workshop drawings, studied and deliberated upon (with the building services personnel) for full disclosure of work sequencing and execution; handholding so to speak.

Always bear in mind, both success and failure of a project hang solely on the main contractor's shoulder.

Concreting.

3 basic components are involved here:

1. Mixing
2. Transporting
3. Placement.

Mixing time often ranges from 1.5 to 2.5 minutes, a function of the mixer tank capacity.

Transportation of concrete in non-agitating trucks is often restricted to 30 – 60minutes but could be up to 2 hours in agitating trucks.

Different modes of transporting concrete abound; however, the choice made should be such that does not permit segregation and assures workability at point of placement.

Place / pour wet concrete into forms till filled to the top edge; while concrete is being poured, use shovels, trowels, rakes, etc., to move the concrete so that voids or air pockets do not form within it.
The usual practice of shifting wet concrete via Poker vibrators results in segregation and as such, strongly discouraged.

Curing.

Curing is the process of managing the internal body temperature of concrete as the setting process progresses alongside the heat of hydration.

Table 6.1 of BS 8110-1 itemizes minimum period (in days) required for curing of concrete -a function of the cement used, and the average surface temperature of concrete recorded.

The curing process lasts 28 days but the first 48 hours are most crucial.

The most common methods of curing are:

1. Continuous or frequent wetting of surface with water
2. Maintain formworks in place -timber forms basically.
3. Covering the surface with impermeable material such as polyethylene. This should be well sealed and fastened.
4. Spray the surface with liquid chemical curing and sealing compound. This allows curing to progress slowly and helps reduce cracks, curling, and surface discoloration.

Whichever curing modality adopted; we always advise curing progress unimpeded for 5 straight days.

Concreting -indeed site work in general, is a serious business, passion and enthusiasm is expected from all personnel involved.