

Local government of malaysia visited several european countries construction essa...

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IBS has been introduced in Malaysia since early 1960s when Housing and Local Government of Malaysia visited several European states and measure their lodging development plan (Thanoon et al, 2003) After their visit in 1964, the authorities had started foremost undertaking on IBS and the purposes is to rush up the bringing clip and construct low-cost and quality houses.

Project about 7 blocks of 17 narratives level, there are 3000 units of low-priced level and 40 stores lot, about 22. 7 estates of land along Jalan Pekeliling, Kuala Lumpur awarded to JV Gammon & A ; Larsen and Nielsen utilizing Danish System of big panel precast-concrete wall and board slabs and the undertaking was completed within 27 months from 1966 to 1968 including clip taken in the building of the RM2. 5 million projecting pace at Jalan Damansara (CIDB, 2006 ; CIDB2003 and Thanoon et Al, 2003) . The Industrialized Building System or IBS building has been adopted by the Malaysia authorities by doing it compulsory for all authorities undertakings to content 70 % with IBS content, harmonizing to Y. A.

B Dato ' Seri Abdullah bin Hj. Ahmad Badawi, Perdana Menteri dan Menteri Kewangan Malaysia in 2008. Precast concrete is one of the elements being associated with IBS building. The IBS enables pre-cast edifice constituents manufactured at mills, will enable cost economy and quality betterment through the decrease of labour strength and building standardisation. Apart from these, it offers less wastage, less site stuffs, cleaner and neater environment, controlled quality, and lower entire building cost (CIDB, 2003)

. Precast concrete means concrete which has been prepared for casting and the concrete either is statically reinforced or prestressed.

Meanwhile a precast concrete component has limited size and must link with other elements to organize a complete construction. Precast concrete construction refers to the combination of precast concrete elements and the construction is able to prolong perpendicular and horizontal tons or even dynamic tons. The design and building of the articulations and connexions is of import to guarantee the stableness of the overall construction therefore a joint is a mechanism to take attention of the forces action at the interfaces of two or more constructions elements (Kim s. Elliot, 2002) .

2.

2 Precast Concrete System

There are 3 types of precast concrete system. The most common is the additive or skeleton (beams and columns) system. This additive or skeleton system is the combination of beams and columns which are able and strong plenty to defy perpendicular and horizontal tons. The 2nd type is precast panel system which usually built on land and depends on burden bearing wall to defy perpendicular and horizontal tons.

The last system is 3-dimensional or box system which usually used in industrial edifice and warehouse (Abraham Warszawski, 1999) .

2. 2. 1 Linear or skeleton system

Linear or skeleton system is defined as this system usage as their chief structural elements columns, beams, frames, or trusses made of field or

prestressed concrete and their of import characteristics is the capacity to reassign heavy tonss over big spans (Abraham Warszawski, 1999) .

Therefore, they are used in the building of Bridgess, parking tonss, warehouses, industrial edifices, athletics installations and so on. They are composed or built of structural frames, spaced at equal distances, thereby making modular “ cells: that can be repeated a coveted figure of times in longitudinal way or sideways (Abraham Warszawski, 1990) .

Figure 1: Typical strategies of industrial linear system

Different discrepancies of the structural strategy allow for the most convenient breakdown of the frame into connected precast elements.

A rectangular frame is normally composed of two columns and a horizontal beam, connected to achieve stableness in the frame plane so columns possibly fixed at the underside and the beam is freely supported by columns as shown in Figure 1 (a) , which makes it easier for piecing. Columns possibly hinged at the underside and transportation minutes at the top as shown in Figure 1 (B) which does non affect foundations in the transportation of minutes. Besides that, pitched frames can be composed of 2 to 4 parts which depending on their dimensions and the transit and hard-on conditions as shown in Figure 1 (degree Celsius) (vitamin D) (vitamin E) . Single frames can be extended sidewise into every bit many bays as necessary or upward for multistorey edifices as shown in Figure 1 (degree Fahrenheit) , nevertheless, attending must be paid to their sidelong stableness either by debut of stiff connexions at the corners, by poising with

diagonals or by attaching the multiframe to a stiff edifice constituent (Abraham Warszawski, 1999) . The roof may be supported straight on the frames when the precast slabs or Tee beams are used for this intent and it may besides be supported on a precast joist system (Abraham Warszawski, 1999) .

2. 2.

2 Precast panel system

Probably the most widely used types of prefabricated system are those using panel-shaped elements for floor slabs, perpendicular supports, dividers, and exterior walls. Unlike additive system, which is chiefly used as structural framing, panel system besides fulfill interior and exterior infinite enclose maps. These panels may be fabricated with a considerable sum of finish work such as exterior coating, thermic insularity, electrical conduits and fixtures, plumbing, door and window frames and hence significantly cut down the sum of skilled labor on site (Abraham Warszawski, 1999) .

The appellation of precast panel system refers to multistorey constructions composed of big wall and floor concrete panels connected in the perpendicular and horizontal waies so that the wall panels enclose appropriate infinities for the suites within a edifice. Both perpendicular and horizontal panels resist gravitation burden and wall panels are normally one floor high. When decently joined together, these horizontal elements act as stop that transfer the sidelong tonss to the walls (Svetlana Brzev, 2002) .

Figure 2 shown these panels form like a box construction. Figure 2: A large-panel concrete edifice under building (WHE Report 55, Rusian

Federation)An exterior wall that performs all these map is normally of a “ sandwich ” type which it is composed of several beds such as exterior coating, concrete foliages and insularity bed between them.

The overall dimensions of the sandwich wall elements will depends other precast elements. Horizontal slab constituents are used in intermediate edifice floors, level roofs, land floors, landings and platforms (Abraham Warszawski, 1999) . Slabs are normally supported along borders on bearing walls or beams as shown in Figure 3.

The length of support should be at least 60mm, leting for positioning and production tolerances and this length may be reduced to a lower limit if a impermanent support is provided until achieving subsequently a massive connexion as Figure 3 (vitamin D) . Figure 3: Room- size slab: (a) position, (B) subdivision, (degree Celsius) minute connexion, (vitamin D) with impermanent supportThere are several advantages utilizing precast panel system which is this system is high suited for mass production, velocity, no remotion of formwork as the panels are casted at the mill and moved to the site when the concrete has gained adequate strength, quality control as minimal wet work is carried out at the site, it is easy to command the quality of the stuff, craft and lastingness and long-run public presentation as precast panel system besides uses the normal reinforced-concrete which has no lastingness and long-run public presentation jobs (Buddhi S. Sharma, 2004)

2. 2. 3 Three-dimensional or box systems

The 3-dimensional system usage, as their chief edifice component, package units that contain concrete walls and floors.

The units can be either dramatis personae in boxlike casts or assembled in the works from panel elements. In both instances, they can incorporate a significant sum of finish plants such as wall and floor coating, electrical wiring and fixtures, painted and glazed doors and Windowss, plumbing pipes and fixtures, kitchen closets and so on which are made in the works before transporting the faculty to an hard-on site. However, the size of the 3-dimensional or box system faculties is determined by the transit and hard-on considerations (Abraham Warszawski, 1999) .

2. 3 Precast Materials

Materials used for precasting of concrete elements include concrete mix and its constituents included cement, sums, reenforcing steel and assorted alloies (S. G.

Bruggeling and G. F. Huyghe 1991) .

2. 3. 1 Cement

The presently used cements may be broken down by their composing into 4 chief class which is Portland cements made of powdered cinder which consists basically of tricalcium and dicalcium silicates, makes up to 90-95 % of the cement content. Second, Portland cements blended with other stuffs such as scoria, wing ash, or pozzolan, whose measure does non transcend 35 % of unit weight. Third, Blast furnace cement dwelling of cinder and a big

constituent of scoria which more than 35 % and Pozzolanic cement dwelling of cinder and a big constituent of a pozzolanic stuff which more than 35 % (Abraham Warszawski, 1999) .

2. 3. 1. 1 Ordinary Portland Cement

Ordinary Portland Cement is used in the production of most concrete constituents.

The twenty-eighth twenty-four hours compressive strength of a standard howitzer is made with an ordinary Portland cement, varies harmonizing to different national criterions between 20 and 40 MPa. Most often specified mix has a 1: 3 cement and sand ratio and 0. 4-0. 6 H₂O and cement ratio. Its strength after 2 to 3 yearss is 30 to 40 % of the twenty-eighth twenty-four hours strength and after 7 yearss is 50 to 70 % (Abraham Warszawski, 1999) .

2. 3. 1.

2 Rapid Hardening Cement

Rapid indurating cement attains earlier and normally higher strength than comparable ordinary cement. The different types of rapid indurating cements may be of peculiar involvement in precasting to enable a fast turnover of casts. However, they may hold assorted restrictions with regard to their use such as aluminium cement was found to lose a considerable sum of its initial strength under temperatures transcending 25EsC and humid ambient status besides may impact corrosion of support (Abraham Warszawski, 1999) .

2. 3. 1. 3 High- Strength Portland Cement

High-Strength Portland Cement attain up to 50-60 MPa after 20 yearss. Many of these cements develop a full strength of ordinary 20 MPa cement after 1 to 3 yearss (Abraham Warszawski, 1999) .

2. 3. 1. 4 Sulfate-Resisting Portland Cement

This is used in elements exposed to sulfate contact (Abraham Warszawski, 1999) .

2.

3. 1. 5 White Portland Cement

This is similar to Ordinary Portland Cement but a really low Fe content. This cement is used for production of precast architectural concrete constituents with a needed white or coloured surface (Abraham Warszawski, 1999) .

2. 3.

2 Sums

Sums are frequently classified harmonizing to their bulk denseness as lightweight is below 1100 kg/m³, normal weight is 1100-1750kg/m³ and heavyweight is above 210 kg/m³. Normal weight and some types of lightweight sums are used in the production of precast concrete elements. Sums are besides classified harmonizing to their size as mulct is below 5mm diameter and class is 5mm diameter and supra. Normal weight sums (mean denseness 1400-1600 kg/m³) are sand and crushed rock which are found on river bottoms and the coast. Aggregate ' s ascription or characteristic for concrete usage are form, texture, cleanliness, lastingness, chemical

stablness, scratch opposition, volumetric stablness, soaking up and wet content (Abraham Warszawski, 1999) .

2. 3. 3 Air-entraining alloies

These alloies increase the volume of air entrained in concrete from the regular 0-2 % to 4-6 % . They increase the hard-boiled concrete ' s opposition to adverse hoar effects and besides better the concrete mix workability. Air entrainment may cut down concrete strength, particularly early strength. The maximal per centum of entrained air may cut down concrete strength by up to 10-20 % (Abraham Warszawski, 1999) .

2. 3.

4 Accelerating alloies

Admixtures accelerate the concrete hardening procedure which may shorten the clip for precasting. Calcium chloride is one time widely used could do accelerated development of concrete strength. However, the usage of Ca chloride in precast concrete is non permitted any longer because of its caustic influence on reenforcing steel (Abraham Warszawski, 1999) .

2. 3.

5 Steel support

Precast concrete elements can be to a great extent reinforced if necessary because they are cast horizontally. BS8110 permits up to 10 per cent of the cross-section to be reinforced, although this sum is seldom used in favor of higher concrete strengths (Kim s. Elliot, 2002) .

2. 3.

6 Water

It shall be clean and free from stuffs hurtful to concrete.

2. 4 Production engineering

All precast concrete merchandises used in the plants shall be manufactured by precast concrete makers and installed by installers as approved by the Superintendent Officer.

2. 4. 1 Design

Design informations

The magnitude of all tonss used in the design of the precast concrete constituents shall be clearly stated in the drawings. Unless specified otherwise, these magnitudes shall reflect the expected unrecorded tonss and the dead burden from the other constituents including the several precast and cast unmoved concrete constituents. However, these values must non be less than the recommendations which are dead tonss as per British Standards BS6399 Part 1 and 2, Imposed tonss as per Malaysia Uniform Building By-Laws and Wind loads as per Malaysian Standard equivalent (JKR, 2005) . The size, length and the class of concrete used must be clearly specified in the design computations and drawings. Load combinations shall be clearly itemised and identified to enable design look intoing to be carried out upon the most inauspicious conditions.

Unless specified otherwise, the minimal class of concrete used to fabricate the precast concrete constituents shall be 35N/mm² with minimal cement

content of 350 kg/m³ (JKR, 2005) . When precast concrete constituents are designed as prestressed elements, the flexural tensile stress in the concrete should not transcend the Class 2 demands, as stipulated in Clause 4.3.4.3 of British Standard BS8110 Part 1: 1997.

All structural welding, if required shall be done by qualified welders utilizing equipments and stuffs compatible to the basal stuff. The work shall be done wholly in the mill and no structural welding work shall be allowed on site (JKR, 2005) .

2.4.1.2 Design criteria

In general, all precast concrete edifice constituents shall be designed in conformity to the British Standard BS8110 Part 1: 1997 Structural Use of Concrete or the tantamount Malayan Standard or any other tantamount internationally recognized criteria. Design of big prefabricated panels shall be in conformity to the Malayan Standard MS1313: 1993 Code of Practice on Large Prefabricated Panels. Measurements in edifices shall be standardised based on the Modular Coordination constructs as stipulated in the Malayan Standard MS1064: 2001 Guide to Modular Coordination in Buildings (JKR, 2005) .

Detail and drawings

Scheme drawings

Scheme drawings or program shall demo the program position of relevant floors and roof together with the proposed agreements of the horizontal precast concrete constituents, such as the precast concrete floor slabs and

the precast concrete beams. The proposed locations of the columns shall besides be clearly identified. The column-to-floor articulations including the cut-outs on the precast floor slabs.

In add-on, the strategy drawings shall besides bespeak the lifts and cross-sections of the edifice complete with the proposed agreements of perpendicular precast concrete constituents, such as the precast concrete columns and precast wall panels. The column-to-beam connexions, including the truss or other mechanized connections (JKR, 2005) .

Fabrication store drawings

Fabrication store drawings shall demo all necessary dimensions and inside informations to enable the fiction of the precast concrete constituents. These inside informations include the existent dimensions of the precast constituents, sizes and locations of the steel supports, sizes and location of the prestressing wires or strands, concrete screens to steel supports and prestressing wires or strands and inside informations of the conduits for electrical and mechanical services. In add-on to above, fiction store drawings shall besides demo the sectional belongings of the constituents such as the cross-sectional country, minute of inactiveness, modulus of subdivision, distance to impersonal axis together with the designed bending and shear capacities. To guarantee proper handling of the precast concrete constituents, all lifting and hard-on devices should besides be clearly shown in the fiction store drawings (JKR, 2005) .

Prop uping and shoring drawings

All structural precast constituents shall be decently stabilised during hard-on phases by using suited impermanent propping, poising and/or shoring systems. The Contractor shall suggest such a system and produced design computations and drawings to let for safe employment of the system on site (JKR, 2005) .

Certification of computation sheets, method statements and drawings

All computation sheets, method statements and drawings submitted to the Superintendent Officer shall be certified by Professional Engineer registered with the Board of Engineers, so that the submitted paperss are produced in conformity to the accepted technology criterion. Subsequently, the Professional Engineer shall formalize his indorsements by seting his signature and professional seal onto the pages of the submitted paperss (JKR, 2005) .

Prestressing supports

All prestressing stuffs shall be either in the signifier of wires or strands and are produced in conformity to the British Standard BS 5896: 1980 Specification for High Tensile Steel Wire and Strand for the Prestressing of Concrete, or the tantamount Malayan Standard or any other tantamount internationally recognized criterions. If prestressing strands are used in the plants, they all shall be of the low relaxation type (JKR, 2005) .

2. 4. 4 Concrete Works

All concrete plants involved in the fabrication of the precast concrete constituents shall be carried out in conformity to the specification given in the Section D - Concrete Works of the JKR Standard Specification for Building Works (2005 Edition) or other ulterior edition (JKR, 2005) .

2.

4. 5 Fire Rating

Minimum concrete screen to the steel support or prestressing wires, sinews, overseas telegram or sheaths in any structural edifice constituents shall be as specified and in conformity with the fire opposition demands mentioned in the Uniform Building By-Laws. The Contractor shall province clearly in the drawings submitted to the Superintendent Officer the designed fire evaluation of each proposed structural edifice constituent (JKR, 2005) .

2. 4.

5. 1 Good edifice design with fire safety steps

There are 7 considerations which included provide adequate fire contraptions, fire water faucets and other installations to help fire and deliverance forces. Second, provide equal fixed installing for speedy and effectual sensing and extinguishment of fires.

Third, planing and put ining edifice services so that they do no help the spread of fire, smoke or toxic exhausts. Forth, planing and supplying equal and safe flight paths for residents of the edifice. Fifth, by choosing stuffs for the building which will non advance the rapid spread of fire or bring forth

unsafe fume. Sixth, subdividing edifices into compartments of sensible sizes by agencies of fire resisting walls and floors. Last, planing and building the outside of a edifice so that fire us improbable to distribute to it from another firing edifice (UBBL, 1984)

2. 4.

6 Craft

The concrete shall be well free from chipped borders, laitance and honey combs. It shall besides be free from breaks and clefts and from any other defects originating from defective stuffs used or from defective methods of fabrication. The surface of the precast concrete constituents shall non be coated with cement wash. No repairs shall be permitted on the precast concrete constituents under any fortunes. All stuffs, procedures of fabrication and finished precast concrete constituents shall be apt to review and blessing of the Superintendent Officer. Such review may be performed when industry or bringing.

All precast concrete constituents shall be clearly marked with the maker ' s name or registered hallmark or logo, mention figure and projecting day of the month (JKR, 2005) .

2. 4. 7 Precast fabrication procedure

The Architectural drawings are used by structural applied scientists to plan the particular customized panels. Figure 4: Architect pullingIn pre-cast production works, the pre-cast beds or casts are configured as per the drawings supplied by structural technology squad and is prepared for

concrete pouring. Figure 5: Configured casts Concrete is so poured into the molds continue by manus and machine-trowelled Figure 6: Concrete poured into cast and manus and machine-trowelled Steel inserts are molded into the concrete during the panel building. These are welded together at the clip of the panel hard-on to maintain the panel from traveling. Figure 7: Steel inserts are molded into concrete Foam panels are placed in the cast to make bevelled window Sillss.

Figure8: Foam panel Figure9: Window sill Figure10: Bevelled window Sillss Panels are fitted into the floor by infixing the perpendicular reinforcing bars stick outing from the floor slab into big holes in the panel. These big holes are called Dross Backs Figure 11: Impurity Backs for turn uping panel to floor The panels are vertically positioned on the floor slab, so that the reenforcing rods from the floor tantrum absolutely into the Dross Backs. Once in place, grout is pumped into the lower of the two little holes on the side of the panels, make fulling the tubing and locking it to the reinforcing bars. Figure 12: Panel with 2 little holes Electrical conduits are built into the panels.

The panel is drilled to uncover the conduits at point for installing of light switches and stoppers. Figure 13: Electrical conduits are built into panels at the clip of fabrication Figure 14: The panel is drilled to uncover the conduits at points for installing of light switches and stoppers Once the concrete is set, the molds are hydraulicy tilted to perpendicular place for de-molding of the precast panel Figure 15: Finished panel being hydraulicy titled Figure 16: Nearly place for de-molding of the precast panel The panels are removed

from the mold in one twenty-four hours and stood in the drying rack utilizing hook. This enables the fabrication of panels in higher volumes.

Figure 17: The precast panels are stood in the drying rack utilizing maulerss
Figure 18: The panels are removed from the castThe panels are moved to the drying racks. The panels are so stacked in particular drying racks that allow the panels to dry standing up, enabling even bring arounding of the panels. Figure 19: The panels are moved to the drying racks
Figure 20: Precast panels stacked at particular drying racksThe panels are transported to the site in particular transit racks that are lifted and placed onto the paths. A strip foundation or a regular foundation is laid at the site, depending on the geophysical feature of the site. The panels are brought in by truck and erected into topographic point. Figure 21: Particular transit racks that are lifted and placed onto the truck
Figure 22: A strip or a regular foundation is laid at the site
Figure 23: The panels are brought in by truck and erected into topographic pointThe roof is constructed over the vertically erected panels. Floor is completed along with doors and window adjustment.

Completing plants are completed and the edifice is ready for business
(Anmlex Industries PTY. LTD., 1998)

2.

5 Installation

The Contractor shall inform the Superintendent Officer at least one hebdomad in progress of each launching or installing operation and submit

few papers to the Superintendent Officer for credence which are method statement including establishing systems and transit, proposal for traffic recreation and elaborate programme of each launching or installing operation (JKR, 2005) .

2. 5. 1 Transportation system

The Contractor shall cognize for the transit of the precast elements and motion of the lifting equipment to the launching site. Elementss being transported would non be damaged.

Impermanent support for precast concrete constituents during transit must be designed to defy tonss and excess forces during burden, transit and unloading. Precast concrete constituents shall be lifted and supported during fabrication, carrying, transporting and hard-on operations merely at raising or back uping points, as shown in the fiction store drawings, and with sanctioned lifting devices. The Contractor shall guarantee that the precast concrete constituents are loaded in sequence compatible with the needed unloading and hard-on sequence on site. A certification of trial of raising equipment shall be submitted to the Superintendent Officer together with specifics of the experiences of the operator (JKR, 2005) .

2.

5. 2 Site entree and land readying

Contractor is responsible for supplying suited entree to the edifice. The land of the launching country shall be prepared at Contractor ' s ain cost to

guarantee that it is safe to transport the needed burden during installing or launching operation (JKR, 2005 ; Summer 1998) .

2. 5. 3 Placement of precast concrete constituents

The Contractor is responsible for supplying true degree surfaces on all site placed bearing walls and other site placed back uping members. The Contractor shall besides be responsible of arrangement and accurate alliance of ground tackle bolts, home bases or joggle in column termss, grade beams and other site placed back uping members. All relevant shore or propping equipments are besides to be provided by the Contractor if there are any composite beams or slabs (JKR, 2005) .

2. 5. 4 Alliance

Precast constituents shall be decently aligned and levelled as required by the sanctioned fiction store drawings. Variations between next constituents shall be moderately levelled out by jacking, lading or any other executable methods as recommended by the maker and approved by the Superintendent Officer (JKR, 2005) .

2. 5.

5 Safety safeguards during installing

Precautions shall be taken to take any danger to the workers and general populace while establishing precast elements. All lifting equipment shall be designed, if the primary lifting mechanism fails, a secondary mechanism will guarantee that the precast component does non fall. Upon hard-on, a fail-safe method shall be used to temporarily procure the precast unit until the

lasting repair agreements are implemented. The procuring systems which include supplying ironss between the installed precast concrete constituents and stable supports, linking next precast concrete constituents with impermanent braces between them and supplying cuneuss or brackets to the precast concrete constituents.

The Contractor shall inform the S. O and obtain his blessing before taking any impermanent work but such blessing does non alleviate the Contractor of his duties for the safety of the work (JKR, 2005 ; Summer, 1998) .

2. 5. 6 Water Proofing

2. 5. 6.

1 Internal articulations

In the dry country (populating suites, bed suites and shops) approved bituminous based H₂O proofing membrane shall be applied on top of the joint between the slab panels. The terminal of the membrane shall be at least 200mm off from the terminal of the precast concrete floor panel in the joint. In the regularly wet country, (bathrooms, lavatories and kitchens) , liquid H₂O proofing membrane shall be applied over the full floor country with excess 200mm lower limit up the walls. Water proofing alloies insert in the concrete screeds that are later laid on top of the concrete floor topping.

Additives are besides added to the concrete placed in the articulations to better workability and cut down shrinking. In either country (dry or moisture) , cast unmoved concrete topping of class similar to the class of concrete used in the fabrication of the precast concrete constituents is laid

on top of the sealing stuffs. When the concrete topping is designed to move as a composite with precast concrete floor panel, the minimal thickness of concrete exceeding shall be 60mm.

In other instances, the minimal concrete exceeding thickness shall be 30mm merely (JKR, 2005) .

2. 5. 6. 2 External articulations

Both horizontal and perpendicular articulations should be designed as ' open-drained ' articulations, intending any H₂O in the joint can flux down and discharged out on its ain by gravitation.

Both, perpendicular and horizontal articulations shall so be hidden by put ining aluminium strips on top of the channels and attaching one terminal of the strip to the wall (JKR, 2005) .

2. 5. 6. 3 Leakage trial

In the regularly moisture countries, 24-hour H₂O ponding trials shall be carried out.

In this trial, the country to be tested shall be inundated with 50mm deep standing H₂O for a uninterrupted 24 hr period. After the 24-hour period is over, a thorough review is carried out to observe any mark of H₂O escape in and around the trial country. The trial is deemed successful when no mark of any escape is detected (JKR, 2005) .

2. 5. 7 Independent checker

2.

5. 7. 1 Introduction

Independent Checking Engineer shall take full duty of his study and urge that it has been adequately carried out in conformity with recognized technology pattern, and to guarantee the structural unity and stableness of the proposed building. The Checking Engineer should measure, analyses and reexamine the structural design in the program and execute such original computations with a position to finding the adequateness of cardinal elements and verify that the cardinal elements designed are consistent with general layout shown and in any amendments (JKR, 2005) .

2. 5. 7. 2 Scope of checker

Sufficient working pulling inside informations and specifications shall be available to the checker to look into. The checker in transporting out this is required to find and utilize of the Code of Practice and Design Standards in the programs, look into the design burden and method of building, look into the criterions and specifications of stuffs to be used, ascertain the structural design construct used and place the cardinal structural elements, analyses all cardinal structural elements of the edifice and the associated construction to be built, find the stableness of the structural frame, look into structural particularization ; and find the adequateness of other facets of the design which are curious to the edifice and the associated constructions to be built and which are indispensable to the structural unity of the plants (JKR, 2005) .

2. 5. 7. 3 Coverage of independent cheque

The checker ' s study shall be submitted in composing to the Superintendent Officer within 2 hebdomads of the independent cheque being done. The study should specifically depict the lacks or possible to be which have been identified along with the relevant mentions to recognized criterions, patterns and design rules.

The lacks should be illustrated wherever possible by marking-up the programs or with studies, drawings and such related stuffs. The study may include the draughtss suggestion, amendments, alternate solutions and designs for amendments and or alternate solutions. A sum-up of all the draughtss and interior decorators comment with or without their understanding shall be included (JKR, 2005) .