**TERMS OF REFERENCE**

**FOR**

**PROFESSIONAL SERVICES**

**OF**

**CIVIL AND STRUCTURAL ENGINEERING WORKS USING BUILDING INFORMATION MODELING (BIM) INCLUDING OTHER ASSOCIATED WORKS**

**IN CONNECTION WITH**

**(PROJECT TITLE)**

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**1.0 INTRODUCTION**

The Government of Malaysia (hereinafter referred to as “the **Government**”) wishes to appoint a Consulting Engineer (hereinafter referred to as “**CE**”) to provide professional services in the discipline of civil and structural engineering including other associated engineering works, to enable the Government to implement project successfully. The professional services provided by the CE shall be in Building Information Modeling (BIM) Methodology. Relevant services required from the CE shall include civil and structural engineering modeling, analysis, design, preparation of work and material specifications, acting as submitting person on behalf of the Government in obtaining Planning Permission from relevant Local Authority, preparation of tender drawings, construction drawings, and supervision on site.

The CE shall provide everything necessary for the proper execution of the BIM works until its completion according to the true intent and meaning of the Contract taken together whether the same may or may not be particularly shown or described provided the same can be reasonably inferred therefrom.

In order for the physical implementation of the Government’s project to be on schedule, the deliverables such as design models, drawings, details, plans, calculations and reports all duly signed by the CE together with the relevant specifications must be ready by (the target date) …………………

**2.0 OBJECTIVES**

The main objective of procuring professional services is to make available comprehensive civil and structural engineering design, drawings, details, plans and specifications on the stated target date to enable practical implementation of the Government’s project to be as scheduled. In addition, the professional services rendered must consider the following requirements:

2.1 Safe, functional and stable structure and infrastructure.

2.2 Buildable and economical to construct.

2.3 Durable and economical to maintain.

**3.0 PROJECT SCOPE OF WORKS**

A brief description of the Project and the project scope of works are given in Appendix ‘A’ attached.

**4.0 SCOPE OF PROFESSIONAL SERVICES**

**4.1 Types of Services**

In general, the CE shall provide Basic Professional Services as described in the schedule for engineering consultancy services, Part A: SCHEDULE OF SERVICES Form CSA2014 – Engineering (Amendment 2018) under the relevant Type of Services of CE under the following engineering areas:-

**4.1.1 Civil and Structural Engineering Services**

The services required include the modeling, analysis, design, preparing of specification and all other technical services necessary to produce comprehensive civil and structural engineering drawings and other documents ready to be used for tender and construction purposes. The services shall be rendered for the following part of the project scope of works:-

a) substructure (i.e building components located between and including the foundation system and the ground beams)

b) superstructure (i.e building components located between and including the ground floor column and the roof beam)\*

(\* delete if not required)

c) roof structure/ roof truss\*

(\* delete if not required)

d) earthworks, internal road, drainage, external water reticulation, sewerage, and other external works required for the project site

**4.1.2 Geotechnical Engineering Services**

The services required include site investigation, analysis, design, preparation of specification and all other technical services necessary to produce comprehensive geotechnical engineering recommendations, drawings and other documents ready to be used for tender and construction purposes with compliance to the Geotechnical Design Requirement in Appendix ‘B’. The services shall be rendered for the following part of the project scope of works:-

1. Site Investigation Works
2. Site Investigation Interpretative Report
3. foundation for structures
4. slopes, embankments and retaining structures
5. ground improvements
6. other related geotechnical works

**4.1.2.1 Material Survey and Subsurface Investigation**

a) With Site Investigation Data\*

The Government may provide the preliminary subsurface investigation results to the CE.

The preliminary subsurface investigation locations are indicative only and to be used as a preliminary/general guide only, the Government is not obliged to guarantee the completeness of the soil investigation locations.

The preliminary subsurface investigation results are to be used as a preliminary/general guide only for geotechnical preliminary design purposes. The Government will not be responsible for any inaccuracies and the completeness of the subsurface data presented.

If the data or the report provided by the Government is insufficient, the CE shall provide additional information required/ additional subsurface investigation for the required data to complete the detailed design where deemed necessary for the proper and satisfactory design of the geotechnical works, in accordance with the best engineering practice.

The CE shall propose, coordinate and supervise sufficient subsurface investigation, sampling and testing to gather enough data. A detail material and subsurface investigation are required to permit final detailed design of all structures, slopes, foundations, ground treatments, road pavements, etc.

The CE shall determine the required scope of subsurface investigation and submit his proposals to the Government for concurrence.

b) Without Site Investigation Data\*

The CE shall propose, coordinate and supervise sufficient subsurface investigation, sampling and testing to gather enough data. A detailed material and subsurface investigation are required to permit final detailed design of all structures, slopes, foundations, ground treatments, road pavements, etc.

The CE shall determine the required scope of subsurface investigation and submit his proposals to the Government for concurrence.

(\*delete if not required)

The Government who shall enter into an agreement with the soil investigation contractor shall do the appointment of the soil investigation contractor.

The CE shall consider proposing additional subsurface investigation and tests in the Tender Document for confirmatory purpose for the detailed design during construction stage.

The CE shall administer the contract and shall be responsible to provide full supervision to ensure that the works are carried out properly.

The Final Soil Investigation Report shall be endorsed and certified by a Professional Engineer (i.e. The CE).

All subsurface investigation/additional subsurface investigation works shall be carried out in accordance with the following: -

1. JKR Standard Specification for Site Investigation: JKR/SPJ/2013-S17
2. Malaysian Standard MS 2038: 2006: Code of Practice for Site Investigation
3. Malaysian Standard MS 1056: 2005: Soils for Civil Engineering Purposes (Test Method)
4. Relevant Standard Engineering Practice

In conjunction with the subsurface investigation, the CE shall also carry out a material survey in the location of the proposed new route or improvement and its vicinity to identify the sources of suitable borrow and construction material. He shall also provide verification as to their quality, quantity and suitability.

The CE is required to submit a Material Survey and Subsurface Investigation Report as soon as the subsurface investigation works are completed.

The report shall give a general description of the geology of the area, results of the material survey and details of the sources, quantity and quality of the available materials as well as their relevance to the project.

The report should also highlight the results of the subsurface investigation giving details of the CE's interpretation of those results as well as its implications on geotechnical aspects of the design.

**4.1.3 Other associated services**

In addition to the above, the CE is also required to provide the following associated services:-

1. acting as Submitting Person (SP) on behalf of the Government in submitting related Form Gs (as listed below) and other documents for approval from relevant Local Authority for issuance of Certificate of Completion and Compliance (CCC) including for Pre-Approved Plans (PAP) blocks/ buildings if any
   * + 1. G1 - Kerja Tanah
       2. G3 - Asas Tapak
       3. G4 - Struktur
       4. G13 - Sistem Bekalan Air Luaran
       5. G14 - Retikulasi Pembetungan
       6. G15 - Loji Rawatan Pembetungan
       7. G17 - Jalan dan Parit
       8. G19 - Parit Luaran Utama
2. acting as submitting person on behalf of the Government in submitting related documents for approval from relevant Local Authority in Sabah and Sarawak for issuance of Occupation Certificate (OC) or Occupation Permit (OP) respectively, including for PAP blocks/ buildings if any\*
3. preparation of tender document\*
4. supervision on site, including auditing designs submitted by Contractors\*

(\* delete if not required)

**4.1.4 Design Checking**

The design shall be checked and approved by Profesional Engineer and shall be submitted with the full report.

**4.2 Stages of Services**

As outlined in the schedule for engineering consultancy services, PART A: SCHEDULE OF SERVICES Form CSA2014 – Engineering (Amendment 2018) the professional services shall be divided into five (5) stages.

**4.2.1 Preliminary Stage**

The required services to be provided by the CE are described under the Part A: SCHEDULE OF SERVICES.

**4.2.2 Design Stage**

The required services to be provided by the CE are described under the Part A: SCHEDULE OF SERVICES.

Upon receiving the architectural models and drawings from the Government, the CE shall evaluate the completeness of the drawings for the purpose of, civil & structural engineering, and geotechnical analysis and design.

The CE shall obtain any additional relevant or important information deemed essential for the completion of the design works on their own accord from various authorities.

The CE shall propose Civil & Structural, and Geotechnical Design Concept for agreement. A review of the Design Concept shall be carried out by the CE as and when requested by Government.

The CE shall be expected to supply the following information to the Government:

1. roof support reactions
2. structural key plans
3. foundation plans
4. earthwork layout plan
5. road and drainage layout plans
6. external water reticulation layout plan
7. external sewerage layout plan
8. design progress report at every stages of service
9. other drawings or documents as required by Government

As soon as the agreement is reached with regard to the design concept of the civil and structural works the CE shall proceed by executing the detail modeling, analysis, design, and preparing of specifications relevant to the respective parts of the project.

The CE shall provide BIM models created with Level of Development (LOD) and Parameter Names required for each project phases specified in Appendix E.

The model developed shall be in manageable order by using project navigation, naming convention and project template according with ‘Garis Panduan BIM JKR’ and ‘Piawaian BIM JKR’

The CE shall be required to satisfy the following requirements:-

1. New Design\*\*

a) Substructure of buildings

The CE shall produce complete engineering drawings showing all component sizes, type of materials, strength of materials, amount of reinforcements and other relevant information to allow the substructure to be constructed on site.

The CE shall also be required to inform the Government on the design standard, structural assumptions, analytical model and loading values to be used (unless specified by the Government), sizes of members, types of materials and strength selection to enable the appointed Contractor to propose appropriate IBS components for the superstructure.

b) Superstructure of buildings

The CE shall apply Industrialized Building System (IBS) requirements when executing the detail analysis, design and specification preparation relevant to this part of work. All designs shall comply the minimum total score of 70 in accordance with latest Pekeliling Perbendaharaan and minimum score of 40 for Part 1: Structure System.

The CE shall produce complete engineering drawings showing all component sizes, type of materials, strength of materials, amount of reinforcements and other relevant information to allow the component to be manufactured by competent manufacturers.

Notwithstanding the above, should the Government decided to exempt the CE partly or fully from having to comply with the requirements stated above, the Government shall communicate such exemption to the CE in writing.

c) Roof structures

i. *Designed by Prefabricated Roof Truss Provider\**

The CE is not required to provide any professional services for this part of the building.

ii. *Designed by* CE\*

The CE shall utilize either local timber of appropriate strength group or Hot Rolled Structural Steel of appropriate grade as the material for roof structures.

The CE shall produce complete engineering drawings showing all component sizes, type of materials, strength of materials, joint details, bracing details and other relevant information to allow for the roof structure to be prefabricated.

(\* delete if not required)

1. Pre-Approved Plans (PAP) Design\*\*

a) Substructure of buildings

The CE shall produce complete engineering drawings showing all component sizes, type of materials, strength of materials, amount of reinforcements and other relevant information to allow the substructure to be constructed on site.

The CE shall also be required to inform the Government on the design standard, structural assumptions, analytical model and loading values to be used (unless specified by the Government), sizes of members, types of materials and strength selection to enable the appointed Contractor to propose appropriate IBS components for the superstructure.

(\*\* delete if not required)

During the development of detail design stage, The CE shall carry out and participate in the Design Coordination process with the architect and others consultant to produce Coordinated Design Model. The CE shall produce Tender Drawings and Construction Drawings generated from the Coordinated Design BIM Model.

Structural detailed drawings including key plan and detailing shall be generated from the model. However, the following details are not required to be modeled but shall be incorporated/linked (CADlink) into the model for references.

a) Concrete reinforcement details (rebar);

b) Connection details of structural members; and

c) Base plates, clip hangers, fixing etc.

Structural design criteria such as material properties and design parameters whichever appropriate shall be included in the structural model.

Civil detailed drawings produced shall be fully auto generated from the Coordinated Civil Model. However, in some circumstance, the CE may also include 2D drafting within the same coordinated design model.

The CE is expected to carry out Civil & Structural, and Geotechnical Design Review at the completion of the services at the end of this stage;

1. Preliminary design review
2. Detailed design review

All civil and structural models, drawings and specifications shall be compiled in a well documented form suited for submission to the Government.

The model quality shall include but not limited to:

1. Components with accurate geometry, function, type, coding, specification, material, graphic and associated parameters according to LOD requirements;
2. Materials with coding, specification, graphic and rendered properties according to LOD requirements;
3. An efficient, consistent and accurate modeling practice with acceptable related warnings: e.g. eliminate object overlap, incorrect close wall intersections, etc.;
4. Parametric models and components with dimension accuracy according to design intent, analysis and construction;
5. Models with correct application of material and functionality;
6. The use of correct component classification for modeling: e.g. the use of structural column category object for a round column;
7. The maintenance of parametric linkages within the model at all times to enable automatic generation of all plans, sections, elevations, custom details and schedules as well as 3D views. Documentation of the models shall not happen outside of the BIM software;
8. The use of appropriate and interoperable viewing, checking, and output file formats such as \*.dwfx, \*.nwd, etc.,
9. The use of model checking tools (e.g. Navisworks Manage) to confirm the validity and accuracy of files/models and adherence to design requirement/need statement.

**4.2.3 Tender Stage**

The required services to be provided by the CE are described under the Part A: SCHEDULE OF SERVICES.

At the award of tender, the CE shall review the submission from the winning tenderer to ensure that the proprietary IBS system components proposed are compatible with the CE’s substructure design.

**4.2.4 Construction Stage**

The required services to be provided by the CE are described under the Part A: SCHEDULE OF SERVICES.

**4.2.5 Defects Liability Period Stage**

The required services to be provided by the CE are described under the Part A: SCHEDULE OF SERVICE.

**5.0 DURATION OF SERVICES**

The CE shall provide the services from the date of CE’s Letter of Acceptance until \*the end of Defects Liability Period (DLP)/ \*Final Account of the project.

(\*Delete if not required)

**6.0 COST OF SERVICES**

The professional fees of CE is based on \*Fixed Fees/ \*Man-Months Input and shall comply with the latest Pekeliling Perbendaharaan.

(\*Delete if not required)

**7.0 ADHERENCE TO JKR’S INTEGRATED MANAGEMENT SYSTEM (SISTEM PENGURUSAN BERSEPADU)**

All design shall conform to the Quality Management System JKR (QMS:MS ISO 9001:2008), Environmental Management System JKR (EMS: MS ISO 14001:2004), Occupational Health and Safety Assessment Series JKR (OHSAS 18001:2007) and Energy Management Systems – Requirements With Guidance For Use (ISO 50001:2011,IDT) (MS ISO 50001: 2011 (COMFIRMED:2015)).

**8.0 INFORMATION TO BE PROVIDED BY THE GOVERNMENT**

The following information will be given to the CE.

1. a set of architectural models and working drawings
2. site and survey plan
3. site investigation reports\*
4. Column loads, if the superstructure does not form part of the scope of the professional services.
5. All other necessary information deemed fit.

(\*Delete if not required)

While every co-operation is given to the CE, it is the responsibility of the CE to collect all the information that is needed in the execution of this assignment. The CE should undertake to visit the site to ascertain himself the specific requirements of the project before commencing works.

**9.0 SUBMISSION OF REPORTS, SCHEDULE AND DOCUMENTS**

**9.1 Implementation Schedule**

The CE shall submit a Design Development Implementation Schedule that outlined the detailed work program within one (1) week of the appointment for Government approval. The CE shall ensure that the Schedule submitted conforms to the required time period as stipulated in the JKR Q-Plan as attached in Appendix ‘C’.

Non-adherence to the approved Design Development Implementation Schedule may result in the CE being imposed with Liquidated and Ascertained Damages (LAD).

**9.2 Schedule of Personnel**

Within one (1) week after the appointment of the CE, the CE is to furnish a list of personnel involved in the professional services indicating their inputs corresponding to each component of work and the implementation schedule. This should include submission of curriculum vitae of all professional personnel. Well qualified and experience personnel shall be provided at all times.

**9.3 Submission of Tender Drawing**

The CE shall submit minimum 30 sets of copy prints of the Tender and Contract Drawing to the Government as scheduled in Q Plan.

**9.4 Final Design Report/ Calculation**

Two (2) copies each of hardcopy and softcopy of the final design report and design calculations shall be submitted on completion of the final design.

The design report shall be an overall picture of the Project and scope of works involved, the criteria or rationale used for each of the design components and the events and decisions that were made as regards to design changes along the way. The design report shall be in a format as given in Appendix ‘D’.

The design calculations shall be properly bound and set out in the order of design. The design calculations must be complete, legible to be read and must clearly refer to the relevant clauses of the design codes used.

**9.4.1 Other Documents**

Other documents as scheduled to be submitted shall include:

* + 1. Complete set of final Drawings for review
    2. Final submissions of five (5) sets of well documented Construction Drawings and specification
    3. Complete set of duly signed and endorsed original transparency (tracing) and one (1) set of endorsed drawing (softcopy) in external hard drive.
    4. Other documents deemed necessary

**9.5 Certification by Professional Engineers**

All drawings and documents submitted must be duly signed/ certified by professional engineers duly registered with the Board of Engineers Malaysia.

**10.0 OTHER TERMS AND REQUIREMENTS**

**10.1 Design Code**

The services of the CE shall comply with the latest relevant Malaysian Standards or Eurocode or any other International Standard if such codes are not available.

**10.1.1 Seismic Design Requirements**

For projects with seismic requirement as determined in MS EN 1998-1 and Malaysia National Annex to MS EN 1998-1, the design shall comply with the code’s design requirement.

**10.2 Building Information Modeling**

**10.2.1 BIM Guideline and Standards**

The services of the CE shall comply with the latest Garis Panduan BIM JKR and Piawaian BIM JKR.

**10.2.2 BIM Project Execution Plan (BPEP)**

The CE shall provide all necessary information required by the Government for the purpose of BPEP Development in accordance to the requirements as specified in Garis Panduan BIM JKR.

**10.2.3 BIM Platform and Software**

All models shall be provided to Government as per latest version of software as stated in Table 1 and all at the expenses of the CE. The models submitted shall come with the related linked file/s.

|  |  |
| --- | --- |
| Application Area | Software |
| Model Creation with associated data | Revit |
| Drawing Production/Generation and Documentation | Revit |
| Clash Detection Analysis and Visualisations | Navisworks |
| Civil Model Creation and Drawings Production | AutoCad Civil 3D |

Table 1: BIM Software

**10.3 Calculations for Industrial Building System (IBS) Content**

Calculations to determine the IBS content is based on the latest Manual IBS Content Scoring System (IBS Score) by CIDB. The CE must submit calculations for IBS Score points obtained when submitting structural drawing for verification. The Consultant shall also follow all the guideline published by CIDB.

**10.4 Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST)**

The CE shall take into account the requirement of MyCREST in the design if the cost of project is more than RM50 millions.

**10.5 Discrepancies Between Architectural, Mechanical, Electrical and Civil & Structural Drawings**

It is the responsibility of the CE to ensure that no discrepancy occurs between drawings. If discrepancies due to negligence of the CE are discovered at any stage, then the CE is liable for the cost of rectification. The CE is also required to come up with a working proposal for rectification at his own cost.

**10.6 Construction Difficulties**

The CE must ensure that the building can be constructed without difficulties. In other words the CE has to consider this aspect in his design so that the cost is not unnecessarily increased due to poor consideration for construction.

In cases where special technique is required and it is not available locally, the CE must inform and get the approval of Government before proceeding with the design. In asking for such approval the CE must come up with the proposals and cost estimates.

**10.7 Design and Inadequacy During Construction**

The CE must ensure the adequacy of the design. In cases of construction failure the CE will undertake to give advice and detailed repair proposal. Any failure due to design inadequacy shall be borne by the CE.

**10.8 Failure of the Works After Construction**

In the event of failure of the Works after construction, the CE will bear the cost of remedial work if the failure is due to his negligence in design.

**10.9 Maintenance of Building and Services**

The CE should take into consideration the maintenance aspect of the building and services in their designs. In principle the structure should be easily maintained. Where specialised maintenance is anticipated, the CE should advice the Government on the matter and to seek approval before proceeding with the design.

**10.10 Specifications**

JKR Standard Specification for the relevant works shall form the basis of the design requirement. Where necessary, the CE shall provide details and other required specification for special requirements as stated in the Scope of Services. The CE shall also incorporate requirements on safety aspect in construction into the specification*.*

**10.11 Transfer of Technology**

The CE will also undertake to provide the training and transfer of technology to the JKR personnel involved in the project, when necessary.

**11.0 PROJECT COORDINATOR**

The Government reserves the right to assign a project coordinator for close monitoring during the design period.

**12.0 LIAISON AND APPROVAL FROM OTHER AGENCIES**

In case the CE requires the cooperation of Government Departments and Agencies, the Government shall provide liaison and shall assist the CE to gather information required for the completion of the project.

Where applicable, the onus of obtaining timely approval from each relevant Local Approving Authority for each design drawing shall be with the CE.

**13.0 GOVERNMENT INDEMNITY**

The CE shall be responsible for any damage to life and property that may arise out of their works and they shall take all necessary insurance cover to indemnify the Government from any claims for compensation that may arise through their negligence.

**14.0 PROCEDURE FOR REIMBURSABLE CLAIMS**

All reimbursable items especially out of pocket expenses shall be claimed on a monthly basis.

**15.0 CHECK CONSULTANT**

In the event as required, the CE shall provide full co-operation and assistance to any check consultant appointed by JKR in this project.

**16.0 AGREEMENT**

The CE shall prepare 1+1+9 sets (original + certified duplicate copy + copy) of agreement for signing not later than four (4) months after the date of the Letter of Acceptance.

**17.0 SITE SUPERVISION**

**17.1** The CE shall be responsible for the supervision of the civil and structural works including certifications of all works.

**17.2** The CE shall ensure all supervisory staffs are stationed at the site as soon as the construction works commences and at all time until the construction is completed or instructed by JKR otherwise.

**17.3** The CE shall follow strictly the instructions issued by the Superintending Officer (S.O.) of the Project in carrying out the supervision of the works.

**17.4** The scope of works shall be given out by the Superintending Officer (S.O.) concerned.

**17.5** The CE shall endorse As-Built Drawings submitted by the Contractor at the end of the project. The As-Built Drawings endorsed shall be generated from As-Built Models.

**17.6** The CE shall submit the QA/QC report monthly which includes:

1. Summary of quality control report
2. Building materials approval
3. Non conformance product (NCP)
4. Testing report\*
5. Request for inspection (RFI)
6. Approved Method Statement\*
7. Environmental Management Plan\*
8. Occupational Health and Safety Plan\*

(\* delete if not required)

**APPENDIX ‘A’**

**SCOPE OF WORKS FOR CIVIL AND STRUCTURAL ENGINEERING WORKS INCLUDING OTHER ASSOCIATED WORKS**

**IN CONNECTION WITH**

**(……………………PROJECT TITLE…………………….)**

Scope Of Works

1. Structural engineering design of “Superstructure and Substructure” for the following buildings:
   1. \*\*\*\*\*\*\*
   2. \*\*\*\*\*\*\*
   3. \*\*\*\*\*\*\*
2. Relevant civil engineering design – earthworks, drainage system, internal and access roads, sewerage system, external water reticulation as below:

a) Earth Works

b) Roads Works

c) Drainage Works

d) Sewerage Works

e) Water Reticulation Works (with Elevated Water Tank & Pressurised Hydrant System if Necessary)

f) Erosion & Sediment Control Plan (ESCP)

g) Works Outside Boundary

h) Fencing and Gates

i) Retaining Structures

j) Any Other Civil Relates Works

1. Site Supervision Works.
2. Any Civil & Structural Design works as instructed by JKR from time to time (If any)

**APPENDIX ‘B’**

**GEOTECHNICAL DESIGN REQUIREMENT**

1. **General**

The CE shall study and search all report on geotechnical conditions and engineering works that have been carried out. The CE shall undertake further details of site investigation for the purpose of geotechnical engineering design and construction works.

1.1 The following main Codes of Practice and Standards (Latest Edition) shall be applicable for geotechnical engineering works but not limited to:

(i) BS 1377 : Methods of Test for Soil for Civil Engineering

(ii) MS 1056 : Methods of Test for Soil for Civil Engineering

(iii) MS 2038 : Code of Practice for Site Investigation

(iv) BS 5930 : Code of Practice for Site Investigation

(v) MS 1756 : Foundations – Code of Practice

(vi) BS 8004 : Foundations – Code of Practice

(vii) MS 1754 : Code of Practice for Earthwork

(viii) MS 1314 : Precast Concrete Piles

(ix) MS EN 1997-1 : Geotechnical Design

(x) MS EN 1998-1 : Design of Structure for Earthquake Resistance

(xii) JKR Standard Specification for Building Works

(xiii) JKR Arahan Teknik

Including any relevant amendment thereof, shall be adopted by the CE.

1.2 For works which are not covered by the Standard Specifications and for any details where the CE deems necessary to make modifications. The CE shall submit addendum to the Standard Specifications in his proposal, giving complete details of the proposed specification or modification.

1. **Excavation**

2.1 Adequate design for temporary works on deep excavation (depth > 2.0m) and protection to adjacent structures and employees working in an excavation shall be provided.

2.2 Minimum factor of safety of not less than 1.5 is required in the design of excavation protection system such as strut, brace, sheet pile etc.

2.3 In pumping out water / dewatering, the CE shall take into consideration with regard to stability and settlement of all adjacent structures due to the lowering of the water table.

2.4 Adequate safety measures shall be provided and to comply the requirement of relevant local authority’s e.g. signage, hoarding, barriers etc.

**3.0 Filling and Embankment**

Materials used in the construction of fills and embankments shall, as far as possible be those excavated from adjacent cuts. Rock excavated from the cuts may be used as material for fills if they are crushed to acceptable grading envelopes, with maximum size of individual pieces not greater than 100mm. A drying out of the fill material during hauling and handling from cut to position of placing shall have to be allowed for.

**4.0 Ground Treatment**

Ground improvement methods shall enable the works to be carried out in the time frame provided and cost effective. If the ground needs to be improved, environmental friendly ground improvement methods should be adopted. Where surcharge is adopted to improve the ground, no other construction activity shall be allowed until the surcharge is removed.

**5.0** **Retaining Structures**

Any proposed system of retaining structures shall be technically appropriate, cost-effective and aesthetically pleasing. The system shall have been successfully implemented in similar accepted conditions with proven case history.

The design shall be in accordance to BS 8006:1994. The types of foundation for the reinforced structures shall be designed based on the subsoil profile and geotechnical properties of the subsoil at each location. Typical design criteria to be complied with are shown in **Appendix B1**.

Load or bearing tests can also be carried out to assess the foundation capacity.

**6.0** **Slope Drainage System**

6.1 Berm Drain

Berm drain shall be designed to have sufficient capacity to undertake the surface runoff based upon 10 years return period rainfall. Function of berm drain is to minimize water infiltration, surface erosion and design to provide self-cleansing velocity (eg. V-shape cast in-situ concrete drain).

6.2 Cascading Drains

Cascading drains in slope faces shall be provided in addition to normal cut off drains at the top of slope and berm drains. Cascading drains shall be provided for all 1:1.5 cut slope surface and all fill slope surfaces which have 1:2 or steeper gradient.

6.3 Subsurface Drains

Subsurface drains such as horizontal drains or drainage blankets shall be provided for cut and fill slopes and for areas where the groundwater/perched water table is found to be high.

**7.0 Foundation**

7.1 The selection of suitable foundation types shall be so chosen to suit the actual soil conditions with regard to the type of structures to be constructed. All timber piles and bakau piles shall not be used in any foundation works in line with government’s environmental policy.

7.2 Pile with size less than 200mm shall not be used for building foundation.

7.3 The foundations of the buildings shall be designed to safely sustain and transmit design loads to the ground, in such a manner as not to cause any settlement beyond tolerable limits that which would impair the stability of, or cause damage to, the whole or any part of the buildings or of any adjoining structures.

7.4 Foundation design shall ensure that foundation movements are within limits that can be tolerated by the proposed structure without impairing its function.

7.5 All foundations shall be designed to provide sufficient factor of safety to support the design loads.

7.6 A bearing capacity factor of safety of not less than 3.0 shall be applied in the design of shallow foundation including strip, pad or raft foundation. In the design of deep foundation including pile foundation, a factor of safety of not less than 2.0 for skin friction and 3.0 for end bearing shall be applied.

7.7 A tensile capacity factor of safety of not less than 2.0 shall be applied in the design of shallow or deep foundation.

7.8 Pile position deviation and verticality tolerances shall be allowed in the design of the foundation works to cover for reasonable inaccuracies in setting out and positioning during construction.

* + 1. The effect of negative skin friction on piles such as surcharge over soft and compressible soils, effect of groundwater draw-down and decomposition of organic layer shall be incorporated in the design of deep foundation.

7.10 Pile selection and installation method shall take into consideration the environmental constraints such as effecting to adjacent structures, build-up areas, heritage buildings, hospitals, schools etc.

* + 1. RC pile used must be in accordance to JKR Standard Specifications or equivalents, commercial grade pile i.e. MS1314: 2004 Class S shall not be used.
  1. Block bearing capacity for pile groups shall be checked to have a minimum factor of safety of 2.0.

7.13 Maximum design structural capacity shall also be discounted for joints (5n%) and slenderness ratio (l/d = 100) where n = number of joints, l = length of pile, d = diameter of pile. Maximum number of joints for piles in marine environment is two (2).

* 1. Static Load Tests shall be in accordance to JKR Standard Specifications and 1% of piles points for each pile size installed or two (2) tests per pile size per site whichever is higher.

7.15 Other relevant tests such as High Strain Dynamic Test (PDA) shall be carry out minimum 3% of total pile points for a consistent ground profile and minimum 7% of total pile points for inconsistent or erratic ground condition.

7.16 Plate bearing test shall be carry out for a minimum two (2) numbers per building for pad/shallow foundation founding on the allowable soil bearing pressure ≥150kN/m2.

7.17 For shallow foundation system, confirmatory test such as JKR Probe or Mackintosh Probe shall be carry out at each column position.

7.18 The CE shall propose adequate foundation design for services (drainage sump, manhole, sewerage and others) to suit the ground condition.

**8.0 Geotechnical Design Criteria**

Typical geotechnical design criteria to be complied with are shown in **Appendix B1.**

8.1 Stability Design for Slopes

8.1.1 Factor of Safety

The short term and long term stability of the fill and cut slope have to be checked. During construction, the short term stability shall be analysed using the Total Stress Strength Parameters like Undrained Shear Strength (Su) for cohesive materials. Stability analysis using the Effective Stress Strength Parameters like c’ and φ’ shall only be carried out to check for the factor of safety against failure in long term and for granular cohesionless materials.

The stability of the fill and cut slope is to be assessed using established limit equilibrium analysis for both circular and non-circular failure surfaces. The following methods can be used such as but not limited to:

1. Simplified Bishop’s Method (Bishop, 1955 and Janbu et.al., 1956) - For Circular Failure Surface
2. Janbu’s Method (1972) - For Non-Circular Failure Surface
3. Morgenstern & Price (1965) - For Non-Circular Failure Surface
4. Sarma (1979) - For Non-Circular Failure Surface

Both circular and non-circular failure surface shall be checked. The shear strength of soils shall be based on the in-situ and laboratory testing carried out. However, the CE\* choice of the parameters does not absolve him of his responsibilities under the Contract.

Factor of safety for slope shall be not less than the value given in **Appendix B1: Typical Geotechnical Design Criteria**.

* + 1. Fill Slopes and Embankments

All fill slope and embankment shall be analysed and designed. Preliminary consideration can be used using gradient of 1V:2H with 2m berm width and maximum height of 6m. For steeper slopes, stabilization measures shall be provided such as but not limited to the followings:

1. Geogrid/ geotextile reinforcement
2. Reinforced concrete retaining structure
3. Reinforced fill structure
4. Replacing the fills with elevated structures, etc.
   * 1. Cut Slopes

All cut slope shall be analysed and designed. This includes cut slopes in residual soils and in completely decomposed rock. For preliminary consideration all untreated slopes shall be designed to 1V:1.5H to 1V:2H with 2m berm width and maximum height of 6m. For steeper slopes, stabilization measures are to be provided such as but not limited to the followings:

1. Soil nailing with slope surface protection/ guniting
2. Permanent ground anchors
3. Retaining walls, etc.

Generally, the maximum number of berms in a cut slope is restricted to six (6) berms unless there is construction difficulty due to the terrain encountered.

8.1.4 Rock Slopes

All rock slopes shall be analyzed and designed. Preliminary consideration can be used using 4V:1H for weathering grade I and 3V:1H for weathering grade II. If analysis indicates that it is unstable, it shall be designed to a better gradient and/or requiring extensive stabilization measures. The type of stabilization measures to be used but not limited to the followings:

1. Permanent rock anchors
2. Rock dowels
3. Rock bolting
4. Buttress walls
5. Counter forts
6. Relief drains / horizontal drains
7. Gunite protective surface seal
8. Wire netting
   * 1. Pore water Pressure Control

Relief drains in the form of horizontal drains and crushed rock drainage blankets shall be provided for cut and fill slopes and for areas where existing water courses have been filled over.

8.1.6 Typical Slope Construction

Some typical slope construction criteria adopted and to comply with **Table 1.**

**Table 1: Typical Slope Construction Criteria**

| **Slope Description** | **No. of**  **berms** | **ExistingSlope**  **Angle** | **Typical Construction** |
| --- | --- | --- | --- |
| SIDE-LONG FILL SLOPE | < 3 | ≤ 35o | Normal Slopes 1V:2H |
| > 3 | ≤ 35o | Reinforced Slopes 4V:1H |
| > 6 | ≥ 35o | Replace with Retaining Structure |
| EMBANKMENTS | < 6 | ≤ 35o | Normal Slope 1V:2H |
| > 6 | ≥ 35o | Reinforced Slope 4V:1H |
| REINFORCED EMBANKMENT | > 6 | ≥ 35o | Replace with Elevated Structure |
| CUT SLOPES | < 6 | - | Normal Slopes 1V:1.5H to 1V:2H with surface drains and 2.0m berms |

8.2 Settlement Consideration

The design of the fill slopes and embankment shall consider both structural and geotechnical solutions to minimize construction cost and considering the time frame available. Alternative designs for ground treatment and fill stabilization are to be prepared following the criteria stated below:

1. Total Settlement
   1. The degree of primary consolidation must achieve 90% during construction.
   2. For post construction settlement, the primary settlement within the first five (5) years of service shall not exceed 10% of the sum of the total theoretical primary consolidation settlement. In addition, total post construction settlement shall not exceed 250mm.
2. Differential Settlement
   1. In areas of transition between piled approach embankments and generally low embankments, differential settlement within the first five (5) years of service shall not exceed 100mm within a length of 50m.
   2. In areas remote from structures and transition zones differential settlement shall not exceed 100mm within a length of 100m.
   3. Notwithstanding the allowable settlement of embankment, the Contractor shall ensure that services particularly water and sewer mains will not be adversely affected by post construction settlement.

During construction, the degree of consolidation and rate of settlement shall be verified on site using field measurement of pore water pressure and settlement. Asoaka’s Method (1978), Hyperbolic Methods or etc. is used to measure settlement and evaluate the settlement rates.

8.3 Effect of Earthquake (if applicable)

8.3.1 The CE shall carry out sufficient ground investigations and/or geological studies to determine the seismic action in areas that are prone to earthquakes in order to incorporate the seismic factor into design.

8.3.2 The CE shall carry out assessment of potential liquefaction or densification hazard of the site and take into consideration in their design, the effect of liquefaction or densification that may lead to risk of ground rupture, slope instability and permanent settlement in the event of an earthquake.

8.3.3 The CE shall ensure that the foundation elements and any earth retaining structure elements provided have sufficient stiffness, stability and strength to resist the effects resulting from the response of the superstructure or any related structure in the event of an earthquake.

**9.0 Instrumentation**

The CE shall also be responsible to provide ground monitoring instrumentations during construction such as piezometer, settlement markers and plates and inclinometer etc, in order to facilitate the monitoring and reporting phase of any ground improvement methods/slope stabilization method:

1. To provide sufficient quantities of instrumentations and equipments required.
2. To provide planning and monitoring instrumentation schedule.
3. To analysis and interpret instrument data
4. To review the design in case monitoring result show noncompliance to assumptions made during design stage.

**APPENDIX B1: SOME TYPICAL DESIGN CRITERIA FOR GEOTECHNICAL WORKS**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **DESIGN COMPONENT** | | | **MODE OF FAILURE** | | **MINIMUM FACTOR OF SAFETY** | **DESIGN LIFE (durability of materials)** | **REMARK** | | | |
| 1. | Slope / Embankment (not on soft ground) | Unreinforced | 1.1  1.2 | Local & Global Stability  Bearing (fill) | 1.3  2.0 | 75 yrs | Analysis should be according to GEOTECHNICAL MANUAL FOR SLOPES (1984), GEO Hong Kong | | | |
| Reinforced or Treated | 1.3  1.4 | Local & Global Stability  Bearing (fill) | 1.5  2.0 | 75 yrs |
| 2. | Embankment on Soft Ground | | 2.1  2.2  2.3 | Bearing (short term)  Local & global slope stability (short term)  Local & global slope stability (long term) | 1.4  1.3  1.2 | 75 yrs | 5 years post construction settlement :  (i) within 50m from structures approach < 100mm  Differential Settlement  Differential Settlement  (ii) within 100m remote from structures < 100mm  Total Settlement <250mm | | | |
| 3. | Permanent Anchors | | 3.1  3.2  3.3 | Tensile Resistance  Resistance at Soil Grout Interface  Creep/corrosion | 2.0  3.0  3.0 | 75 yrs | Geo Spec 1 (1989), GEO Hong Kong  BS 8081 | | | |
| 4. | Rigid Retaining Structures | | 4.1  4.2  4.3  4.4 | Overturning  Sliding  Overall Stability  Bearing | 1.8  1.6  1.5  2.0 | 75 yrs | Max. permissible vertical movement :  15mm along face of wall - Geoguide 1 (1983), GEO Hong Kong | Max. permissible lateral movement :  15mm along face of wall | | Max. permissible differential movement :  1 : 150 along face of wall |
| 5. | Reinforced fill walls/structures | | External Stability | | BS 8006 | 120 yrs | Verticality:  ± 5mm per metre height | Alignment along top (horizontal) :  ± 15mm from reference alignment | | Max. permissible differential movement :  1 : 100 along face of wall |
| Internal Stability | |
| 6. | Individual Foundation Piles (mainly under axial loads) | | 6.1 | Shaft Resistance | 2.0 | 75 yrs | Allowable settlement:  12.5mm along axis of pile at pile head at design load.  38mm or 10% pile size at pile head at twice design load.  Residual settlement not exceed ((diam. of pile or diagonal width for non-circular pile /120) + 4) mm OR 12.5 mm whichever is the lower value.  BS 8004 & JKR Standard Specification for Building Works 2014 | | | |
| 6.2 | Base Resistance | 3.0 |
| 7. | Individual Foundation Piles (mainly under lateral & bending loads perpendicular to axis of pile) | | Ultimate Lateral Resistance | | 2.5 | 75 yrs | Allowable settlement:  12.5mm along axis of pile at pile head at design load  BS 8004 | | Max. permissible lateral movement :  12.5mm perpendicular to axis of pile at design load | |
| 8. | Pile Group | | Block Bearing Capacity | | 2.0 | 75 yrs | Allowable settlement:  12.5mm at Working Load  BS 8004 | | | |
| 9. | Piles as Retaining Structures | | As for 4, 6 & 7 above | | As for individual foundation piles | 75 yrs | As 4 above for rigid retaining structures  BS 8004 | | | |

**APPENDIX ‘C’**

The Q-Plan for this project is enclosed.

**APPENDIX ‘D’**

**FORMAT FOR FINAL DESIGN REPORT**

1. The title page should contain the following information:
2. Name of the Project
3. Name of the Client
4. Address of the Client Name and Address of the Submitting Engineer
5. BEM Registration No. of the Submitting Engineer
6. Approving Authority and its Address\*
7. Approved Building Plan Approval No.\*
8. Date on which construction work is due to commence

(\*Delete if not required)

1. The design report should include but not limited to the following information:
2. Clear indication of the functional frame, load transfer and stability aspects of the structural scheme.
3. Typical design data such as:
4. Type of foundation structure
5. Concrete grades for the various structural elements
6. Design stresses for the materials used for construction, i.e. concrete and reinforcement bars
7. Imposed dead loads and live loads for the various structural elements
8. Design wind speed
9. Minimum design lateral load due to wind load and notional load
10. Design codes of practices, standards and references used for the analysis and design
11. Engineering softwares used for the analysis and design
12. Sufficient design calculations to establish the form and size of all the principal structural element, both for the superstructure and substructure.
13. Sufficient design calculations for the stability analysis and elemental design for the stabilizing frames and walls for the superstructure
14. General arrangement plans, sections to show the dimensions, layout and the disposition of the structural elements with reinforcements details.
15. Complete structural details for temporary works with precautionary measures taken to avoid damages to adjacent properties
16. Construction sequence for the structural works
17. Specifications of the materials.

**APPENDIX ‘E’**

**LIST OF PARAMETERS**

**STRUCTURAL COLUMN**

| Category: Structural COLUMN | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Level of Development | | | | | Parameter | Level of Development | | | | |
| Type | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 | Instance | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 |
| Structural |  | | | | | Materials and Finishes |  | | | | |
| Section Shape |  | √ | √ | √ | √ | Structural Material |  | √ | √ | √ | √ |
| Dimensions |  | | | | | Structural |  | | | | |
| b |  | √ | √ | √ | √ | Gred Bahan\_jkr\_sit |  | √ | √ | √ | √ |
| h |  | √ | √ | √ | √ | Enable Analytical Model |  | √ | √ | √ | √ |
| Identity Data |  | | | | | Rebar Cover - Top Face |  | √ | √ | √ | √ |
| Fire Rating |  | √ | √ | √ | √ | Rebar Cover - Bottom Face |  | √ | √ | √ | √ |
| Description |  |  | √ | √ | √ | Rebar Cover – Other Faces |  | √ | √ | √ | √ |
| Type Mark |  |  | √ | √ | √ | Dimensions |  | | | | |
|  |  | | | | | Volume |  | √ | √ | √ | √ |
| Jenis\_jkr\_stt |  |  | √ | √ | √ | Identity Data |  | | | | |
| Kaedah\_Pemasangan\_jkr\_ stt |  |  | √ | √ | √ | ID\_Tiang\_jkr\_sit |  | √ | √ | √ | √ |
| Kod\_DAK\_Komponen\_jkr\_stt |  |  | √ | √ | √ | Mark |  | √ | √ | √ | √ |
| Saiz\_Fizikal\_jkr\_stt |  |  | √ | √ | √ | Level\_jkr\_sit |  | √ | √ | √ | √ |
| Sistem\_jkr\_stt |  |  | √ | √ | √ | Structural Analysis |  | | | | |
| Sub\_Sistem\_jkr\_stt |  |  | √ | √ | √ | Beban\_Khidmat Tiang\_jkr\_sit |  | √ | √ | √ | √ |
| General |  | | | | | General |  | | | | |
| Nota\_jkr\_stt |  |  | √ | √ | √ | Kod\_DAK\_Lokasi\_jkr\_sit |  |  |  |  | √ |
|  |  |  |  |  |  | Data |  | | | | |
|  |  |  |  |  |  | Jangka\_Hayat\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | No\_Siri\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | No\_Tel\_Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Pengilang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Tarikh\_Dipasang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Tarikh\_Waranti\_Tamat\_jkr\_sit |  |  |  | √ | √ |

**STRUCTURAL FRAMING**

| Category: Structural FRAMING | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Level of Development | | | | | Parameter | Level of Development | | | | |
| Type | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 | Instance | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 |
| Structural |  | | | | | Materials and Finishes |  | | | | |
| Section Shape |  | √ | √ | √ | √ | Structural Material |  | √ | √ | √ | √ |
| Dimensions |  | | | | | Structural |  |  |  |  |  |
| b |  | √ | √ | √ | √ | Gred Bahan\_jkr\_sit |  | √ | √ | √ | √ |
| h |  | √ | √ | √ | √ | Cut Length |  | √ | √ | √ | √ |
| Identity Data |  | | | | | Structural Usage |  | √ | √ | √ | √ |
| Fire Rating |  | √ | √ | √ | √ | Enable Analytical Model |  | √ | √ | √ | √ |
| Description |  |  | √ | √ | √ | Rebar Cover - Top Face |  | √ | √ | √ | √ |
| Type Mark |  |  | √ | √ | √ | Rebar Cover - Bottom Face |  | √ | √ | √ | √ |
| Data |  | | | | | Rebar Cover – Other Faces |  | √ | √ | √ | √ |
| Jenis\_jkr\_stt |  |  | √ | √ | √ | Dimensions |  | | | | |
| Kaedah\_Pemasangan\_jkr\_ stt |  |  | √ | √ | √ | Length |  | √ | √ | √ | √ |
| Kod\_DAK\_Komponen\_jkr\_stt |  |  | √ | √ | √ | Volume |  | √ | √ | √ | √ |
| Saiz\_Fizikal\_jkr\_stt |  |  | √ | √ | √ | Identity Data |  | | | | |
| Sistem\_jkr\_stt |  |  | √ | √ | √ | ID\_Rasuk\_jkr\_sit |  | √ | √ | √ | √ |
| Sub\_Sistem\_jkr\_stt |  |  | √ | √ | √ | Mark |  | √ | √ | √ | √ |
| General |  | | | | | Level\_jkr\_sit |  | √ | √ | √ | √ |
| Nota\_jkr\_stt |  |  | √ | √ | √ | General |  | | | | |
|  |  |  |  |  |  | Kod\_DAK\_Lokasi\_jkr\_sit |  |  |  |  | √ |
|  |  |  |  |  |  | Data |  | | | | |
|  |  |  |  |  |  | Jangka\_Hayat\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | No\_Siri\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | No\_Tel\_Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Pengilang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Tarikh\_Dipasang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Tarikh\_Waranti\_Tamat\_jkr\_sit |  |  |  | √ | √ |

**STRUCTURAL FLOOR**

| Category: Structural FLOOR | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Level of Development | | | | | Parameter | Level of Development | | | | |
| Type | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 | Instance | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 |
| Construction |  | | | | | Constraints |  | | | | |
| Structure |  | √ | √ | √ | √ | Height Offset From Level |  |  | √ | √ | √ |
| Default Thickness |  | √ | √ | √ | √ | Structural |  | | | | |
| Function |  | √ | √ | √ | √ | Gred Bahan\_jkr\_sit |  | √ | √ | √ | √ |
| Materials and Finishes |  | | | | | Structural |  | √ | √ | √ | √ |
| Structural Material |  | √ | √ | √ | √ | Enable Analytical Model |  | √ | √ | √ | √ |
| Identity Data |  | | | | | Rebar Cover - Top Face |  | √ | √ | √ | √ |
| Fire Rating |  | √ | √ | √ | √ | Rebar Cover - Bottom Face |  | √ | √ | √ | √ |
| Description |  |  | √ | √ | √ | Rebar Cover – Other Faces |  | √ | √ | √ | √ |
| Type Mark |  |  | √ | √ | √ | Dimensions |  | | | | |
| Data |  | | | | | Perimeter |  | √ | √ | √ | √ |
| Jenis\_jkr\_stt |  |  | √ | √ | √ | Area |  | √ | √ | √ | √ |
| Kaedah\_Pemasangan\_jkr\_ stt |  |  | √ | √ | √ | Volume |  | √ | √ | √ | √ |
| Kod\_DAK\_Komponen\_jkr\_stt |  |  | √ | √ | √ | Thickness |  | √ | √ | √ | √ |
| Saiz\_Fizikal\_jkr\_stt |  |  | √ | √ | √ | Identity Data |  | | | | |
| Sistem\_jkr\_stt |  |  | √ | √ | √ | ID\_Papak\_jkr\_sit |  | √ | √ | √ | √ |
| Sub\_Sistem\_jkr\_stt |  |  | √ | √ | √ | Mark |  | √ | √ | √ | √ |
| General |  | | | | | Level\_jkr\_sit |  | √ | √ | √ | √ |
| Nota\_jkr\_stt |  |  | √ | √ | √ | General |  | | | | |
|  |  |  |  |  |  | Kod\_DAK\_Lokasi\_jkr\_sit |  |  |  |  | √ |
|  |  |  |  |  |  | Data |  | | | | |
|  |  |  |  |  |  | Jangka\_Hayat\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | No\_Siri\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | No\_Tel\_Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Pengilang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Tarikh\_Dipasang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Tarikh\_Waranti\_Tamat\_jkr\_sit |  |  |  | √ | √ |

**STRUCTURAL WALL**

| Category: Structural WALL | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Level of Development | | | | | Parameter | Level of Development | | | | |
| Type | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 | Instance | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 |
| Construction |  | | | | | Structural |  | | | | |
| Structure |  | √ | √ | √ | √ | Gred Bahan\_jkr\_sit |  | √ | √ | √ | √ |
| Width |  | √ | √ | √ | √ | Structural |  | √ | √ | √ | √ |
| Function |  | √ | √ | √ | √ | Enable Analytical Model |  | √ | √ | √ | √ |
| Materials and Finishes |  | | | | | Structural Usage |  | √ | √ | √ | √ |
| Structural Material |  | √ | √ | √ | √ | Rebar Cover - Top Face |  | √ | √ | √ | √ |
| Identity Data |  | | | | | Rebar Cover - Bottom Face |  | √ | √ | √ | √ |
| Fire Rating |  | √ | √ | √ | √ | Rebar Cover – Other Faces |  | √ | √ | √ | √ |
| Description |  |  | √ | √ | √ | Dimensions |  | | | | |
| Type Mark |  |  | √ | √ | √ | Length |  | √ | √ | √ | √ |
| Data |  | | | | | Area |  | √ | √ | √ | √ |
| Jenis\_jkr\_stt |  |  | √ | √ | √ | Volume |  | √ | √ | √ | √ |
| Kaedah\_Pemasangan\_jkr\_ stt |  |  | √ | √ | √ | Structural Analysis |  | | | | |
| Kod\_DAK\_Komponen\_jkr\_stt |  |  | √ | √ | √ | Beban Khidmat Tiang\_jkr\_sit |  | √ | √ | √ | √ |
| Saiz\_Fizikal\_jkr\_stt |  |  | √ | √ | √ | Identity Data |  | | | | |
| Sistem\_jkr\_stt |  |  | √ | √ | √ | ID\_Dinding Konkrit\_jkr\_sit |  | √ | √ | √ | √ |
| Sub\_Sistem\_jkr\_stt |  |  | √ | √ | √ | Mark |  | √ | √ | √ | √ |
| General |  |  |  |  |  | Level\_jkr\_sit |  | √ | √ | √ | √ |
| Nota\_jkr\_stt |  |  | √ | √ | √ | General |  | | | | |
|  |  |  |  |  |  | Kod\_DAK\_Lokasi\_jkr\_sit |  |  |  |  | √ |
|  |  |  |  |  |  | Data |  | | | | |
|  |  |  |  |  |  | Jangka\_Hayat\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | No\_Siri\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | No\_Tel\_Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Pengilang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Tarikh\_Dipasang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  |  | Tarikh\_Waranti\_Tamat\_jkr\_sit |  |  |  | √ | √ |

**STRUCTURAL FOUNDATION**

| Category: Structural FOUNDATION (PILE FOUNDATION - PILE) | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Level of Development | | | | | | Parameter | Level of Development | | | | |
| Type | LOD 100 | LOD 200 | LOD 300 | LOD 400 | | LOD 500 | Instance | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 |
| Dimensions |  | | | | | | Materials and Finishes |  | | | | |
| Radius |  |  | √ | √ | | √ | Structural Material |  | √ | √ | √ | √ |
| Minimum Embedment |  |  | √ | √ | | √ | Structural |  | | | | |
| Diameter |  |  | √ | √ | | √ | Gred Bahan\_jkr\_sit |  | √ | √ | √ | √ |
| Depth |  |  | √ | √ | | √ | Enable Analytical Model |  | √ | √ | √ | √ |
| Length |  |  | √ | √ | | √ | Rebar Cover - Top Face |  | √ | √ | √ | √ |
| Width |  |  | √ | √ | | √ | Rebar Cover - Bottom Face |  | √ | √ | √ | √ |
| Identity Data |  | | | | | | Rebar Cover – Other Faces |  | √ | √ | √ | √ |
| Description |  |  | √ | | √ | √ | Dimensions |  | | | | |
|  |  |  |  | |  |  | Elevation at Top |  | √ | √ | √ | √ |
| Data |  | | | | | | Elevation at Bottom |  | √ | √ | √ | √ |
| Jenis\_jkr\_stt |  |  | √ | | √ | √ | Kedalaman\_Cerucuk\_jkr\_ sil |  |  |  | √ | √ |
| Kaedah\_Pemasangan\_jkr\_ stt |  |  | √ | | √ | √ | Identity Data |  | | | | |
| Kod\_DAK\_Komponen\_jkr\_ stt |  |  | √ | | √ | √ | ID\_Cerucuk\_jkr\_sit |  | √ | √ | √ | √ |
| Saiz\_Fizikal\_jkr\_stt |  |  | √ | | √ | √ | Mark |  | √ | √ | √ | √ |
| Sistem\_jkr\_stt |  |  | √ | | √ | √ | Level\_jkr\_sit |  | √ | √ | √ | √ |
| Sub\_Sistem\_jkr\_stt |  |  | √ | | √ | √ | Data |  | | | | |
| General |  | | | | | | Jangka\_Hayat\_jkr\_sit |  |  |  | √ | √ |
| Nota\_jkr\_stt |  |  | √ | | √ | √ | No\_Siri\_jkr\_sit |  |  |  | √ | √ |
| Structural |  | | | | | | No\_Tel\_Pembekal\_jkr\_sit |  |  |  | √ | √ |
| Kapasiti\_Struktur\_jkr\_stt |  |  | √ | | √ | √ | Pembekal\_jkr\_sit |  |  |  | √ | √ |
| Kapasiti\_Geoteknik\_jkr\_stt |  |  | √ | | √ | √ | Pengilang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  | |  | Tarikh\_Dipasang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  |  | |  | Tarikh\_Waranti\_Tamat\_jkr\_sit |  |  |  | √ | √ |

| Category: Structural FOUNDATION (SHALLOW FOUNDATION – PAD FOOTING) | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Level of Development | | | | | | Parameter | Level of Development | | | | |
| Type | LOD 100 | LOD 200 | LOD 300 | LOD 400 | | LOD 500 | Instance | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 |
| Dimensions |  | | | | | | Materials and Finishes |  | | | | |
| Width |  |  | √ | √ | | √ | Structural Material |  | √ | √ | √ | √ |
| Length |  |  | √ | √ | | √ | Structural |  | | | | |
| Thickness |  |  | √ | √ | | √ | Gred Bahan\_jkr\_sit |  | √ | √ | √ | √ |
| Identity Data |  | | | | | | Enable Analytical Model |  | √ | √ | √ | √ |
| Description |  |  | √ | √ | | √ | Rebar Cover - Top Face |  | √ | √ | √ | √ |
| Data |  | | | | | | Rebar Cover - Bottom Face |  | √ | √ | √ | √ |
| Jenis\_jkr\_stt |  |  | √ | √ | | √ | Rebar Cover – Other Faces |  | √ | √ | √ | √ |
| Kaedah\_Pemasangan\_jkr\_ stt |  |  | √ | | √ | √ | Dimensions |  | | | | |
| Kod\_DAK\_Komponen\_jkr\_ stt |  |  | √ | | √ | √ | Elevation at Top |  | √ | √ | √ | √ |
| Saiz\_Fizikal\_jkr\_stt |  |  | √ | | √ | √ | Elevation at Bottom |  | √ | √ | √ | √ |
| Sistem\_jkr\_stt |  |  | √ | | √ | √ | Identity Data |  | | | | |
| Sub\_Sistem\_jkr\_stt |  |  | √ | | √ | √ | ID\_Penapak\_jkr\_sit |  | √ | √ | √ | √ |
| General |  | | | | | | Mark |  | √ | √ | √ | √ |
| Nota\_jkr\_stt |  |  | √ | | √ | √ | Level\_jkr\_sit |  | √ | √ | √ | √ |
| Structural |  | | | | | | Data |  | | | | |
| Kapasiti\_Geoteknik\_jkr\_stt |  |  | √ | | √ | √ | Jangka\_Hayat\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  | |  |  | No\_Tel\_Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  | |  |  | Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  | |  |  | Pengilang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  | |  |  | Tarikh\_Dipasang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  | |  |  | Tarikh\_Waranti\_Tamat\_jkr\_sit |  |  |  | √ | √ |

| Category: Structural FOUNDATION (PILE FOUNDATION – PILE CAP) | | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Level of Development | | | | | | Parameter | Level of Development | | | | |
| Type | LOD 100 | LOD 200 | LOD 300 | LOD 400 | | LOD 500 | Instance | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 |
| Dimensions |  | | | | | | Materials and Finishes |  | | | | |
| Width |  |  | √ | √ | | √ | Structural Material |  | √ | √ | √ | √ |
| Length |  |  | √ | √ | | √ | Structural |  | | | | |
| Thickness |  |  | √ | √ | | √ | Gred Bahan\_jkr\_sit |  | √ | √ | √ | √ |
| Identity Data |  | | | | | | Enable Analytical Model |  | √ | √ | √ | √ |
| Description |  |  | √ | √ | | √ | Rebar Cover - Top Face |  | √ | √ | √ | √ |
| Data |  | | | | | | Rebar Cover - Bottom Face |  | √ | √ | √ | √ |
| Jenis\_jkr\_stt |  |  | √ | √ | | √ | Rebar Cover – Other Faces |  | √ | √ | √ | √ |
| Kaedah\_Pemasangan\_jkr\_ stt |  |  | √ | | √ | √ | Dimensions |  | | | | |
| Kod\_DAK\_Komponen\_jkr\_ stt |  |  | √ | | √ | √ | Elevation at Top |  | √ | √ | √ | √ |
| Saiz\_Fizikal\_jkr\_stt |  |  | √ | | √ | √ | Elevation at Bottom |  | √ | √ | √ | √ |
| Sistem\_jkr\_stt |  |  | √ | | √ | √ | Identity Data |  | | | | |
| Sub\_Sistem\_jkr\_stt |  |  | √ | | √ | √ | ID\_Penapak\_jkr\_sit |  |  | √ | √ | √ |
| General |  | | | | | | ID\_Cerucuk\_jkr\_sit |  |  | √ | √ | √ |
| Nota\_jkr\_stt |  |  | √ | | √ | √ | Mark |  |  | √ | √ | √ |
| Structural |  | | | | | | Level\_jkr\_sit |  |  | √ | √ | √ |
| Kapasiti\_Geoteknik\_jkr\_stt |  |  | √ | | √ | √ | Data |  | | | | |
| Kapasiti\_Struktur\_jkr\_stt |  |  | √ | | √ | √ | Jangka\_Hayat\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  | |  |  | No\_Tel\_Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  | |  |  | Pembekal\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  | |  |  | Pengilang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  | |  |  | Tarikh\_Dipasang\_jkr\_sit |  |  |  | √ | √ |
|  |  |  |  | |  |  | Tarikh\_Waranti\_Tamat\_jkr\_sit |  |  |  | √ | √ |

**STRUCTURAL TRUSSES**

| Category: Structural TRUSSES | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameter | Level of Development | | | | | Parameter | Level of Development | | | | |
| Type | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 | Instance | LOD 100 | LOD 200 | LOD 300 | LOD 400 | LOD 500 |
| Top Chords |  | | | | | Structural |  | | | | |
| Analytical Vertical Projection |  |  |  | √ | √ | Gred Bahan\_jkr\_sit |  | √ | √ | √ | √ |
| Structural Framing Type |  |  |  | √ | √ | Create Top Chord |  | √ | √ | √ | √ |
| Start Release |  |  |  | √ | √ | Create Bottom Chord |  | √ | √ | √ | √ |
| End Release |  |  |  | √ | √ | Bearing Chord |  | √ | √ | √ | √ |
| Angle |  |  |  | √ | √ | Rotation Angle |  | √ | √ | √ | √ |
| Vertical Webs |  | | | | | Bearing Vertical Justification |  | √ | √ | √ | √ |
| Structural Framing Type |  |  |  | √ | √ | Stick Symbol Location |  | √ | √ | √ | √ |
| Start Release |  |  |  | √ | √ | Dimensions |  | | | | |
| End Release |  |  |  | √ | √ | Truss Height |  |  | √ | √ | √ |
| Angle |  |  |  | √ | √ | Non Bearing Offset |  |  | √ | √ | √ |
| Diagonal Webs |  | | | | | Span |  |  | √ | √ | √ |
| Structural Framing Type |  |  |  | √ | √ | Identity Data |  | | | | |
| Start Release |  |  |  | √ | √ | ID\_Kekuda\_jkr\_sit |  | √ | √ | √ | √ |
| End Release |  |  |  | √ | √ | Mark |  | √ | √ | √ | √ |
| Angle |  |  |  | √ | √ | Engineering Type |  |  | √ | √ | √ |
| Top Chords |  | | | | | Level\_jkr\_sit |  | √ | √ | √ | √ |
| Analytical Vertical Projection |  |  |  | √ | √ | General |  |  |  |  |  |
| Structural Framing Type |  |  |  | √ | √ | Kod\_DAK\_Lokasi\_jkr\_sit |  |  |  |  | √ |
| Start Release |  |  |  | √ | √ | Data |  | | | | |
| End Release |  |  |  | √ | √ | Jangka\_Hayat\_jkr\_sit |  |  |  | √ | √ |
| Angle |  |  |  | √ | √ | No\_Tel\_Pembekal\_jkr\_sit |  |  |  | √ | √ |
| Data |  | | | | | Pembekal\_jkr\_sit |  |  |  | √ | √ |
| Jenis\_jkr\_stt |  |  | √ | √ | √ | Pengilang\_jkr\_sit |  |  |  | √ | √ |
| Kaedah\_Pemasangan\_jkr\_ stt |  |  | √ | √ | √ | Tarikh\_Dipasang\_jkr\_sit |  |  |  | √ | √ |
| Kod\_DAK\_Komponen\_jkr\_stt |  |  | √ | √ | √ | Tarikh\_Waranti\_Tamat\_jkr\_sit |  |  |  | √ | √ |
| Saiz\_Fizikal\_jkr\_stt |  |  | √ | √ | √ |  |  |  |  |  |  |
| Sistem\_jkr\_stt |  |  | √ | √ | √ |  |  |  |  |  |  |
| Sub\_Sistem\_jkr\_stt |  |  | √ | √ | √ |  |  |  |  |  |  |
| General |  | | | | |  |  |  |  |  |  |
| Nota\_jkr\_stt |  |  | √ | √ | √ |  |  |  |  |  |  |

**FINAL SURFACE**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Earthworks: Final Surface** | | | | | |
| **Parameter** | **Level of Development** | | | | |
| **Type** | **LOD 100** | **LOD 200** | **LOD 300** | **LOD 400** | **LOD 500** |
| Hyperlink |  |  |  |  |  |
| Katalog |  |  |  | √ | √ |
| Lukisan Terperinci |  |  |  | √ | √ |
| Noted |  |  |  |  |  |
| Jika Berkaitan |  |  |  |  |  |
| General |  |  |  |  |  |
| Jenis Rawatan Tanah |  |  | √ | √ | √ |
| No Kod DAK |  |  |  | √ | √ |
| Nama Pembekal |  |  |  | √ | √ |
| No. Tel Pembekal |  |  |  | √ | √ |
| Tarikh Pasang |  |  |  | √ | √ |
| Tarikh Waranti Pembekal |  |  |  | √ | √ |

**PAVEMENT (LANE/SHOULDER)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Internal Road: Pavement (Lane/Shoulder)** | | | | | |
| **Parameter** | **Level of Development** | | | | |
| **Type** | **LOD 100** | **LOD 200** | **LOD 300** | **LOD 400** | **LOD 500** |
| Hyperlink |  |  |  |  |  |
| Katalog |  |  |  | √ | √ |
| Lukisan Terperinci |  |  |  | √ | √ |
| Noted |  |  |  |  |  |
| Jika Berkaitan |  |  |  |  |  |
| General |  |  |  |  |  |
| Material Turapan (Pave1, Subbase dll) |  |  | √ | √ | √ |
| No Kod DAK |  |  |  | √ | √ |
| Nama Pembekal |  |  |  | √ | √ |
| No. Tel Pembekal |  |  |  | √ | √ |
| Tarikh Pasang |  |  |  | √ | √ |
| Tarikh Waranti Pembekal |  |  |  | √ | √ |

**PAVEMENT (KERB)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Internal Road: Pavement (Kerb)** | | | | | |
| **Parameter** | **Level of Development** | | | | |
| **Type** | **LOD 100** | **LOD 200** | **LOD 300** | **LOD 400** | **LOD 500** |
| Hyperlink |  |  |  |  |  |
| Katalog |  |  |  | √ | √ |
| Lukisan Terperinci |  |  |  | √ | √ |
| Noted |  |  |  |  |  |
| Jika Berkaitan |  |  |  |  |  |
| General |  |  |  |  |  |
| Jenis (Extruded/Block) |  |  | √ | √ | √ |
| No Kod DAK |  |  |  | √ | √ |
| Nama Pembekal |  |  |  | √ | √ |
| No. Tel Pembekal |  |  |  | √ | √ |
| Tarikh Pasang |  |  |  | √ | √ |
| Tarikh Waranti Pembekal |  |  |  | √ | √ |

**DAYLIGHT**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Internal Road: Daylight** | | | | | |
| **Parameter** | **Level of Development** | | | | |
| **Type** | **LOD 100** | **LOD 200** | **LOD 300** | **LOD 400** | **LOD 500** |
| Hyperlink |  |  |  |  |  |
| Katalog |  |  |  | √ | √ |
| Lukisan Terperinci |  |  |  | √ | √ |
| Noted |  |  |  |  |  |
| Jika Berkaitan |  |  |  |  |  |
| General |  |  |  |  |  |
| Jenis Slope Protection |  |  | √ | √ | √ |
| No Kod DAK |  |  |  | √ | √ |
| Nama Pembekal |  |  |  | √ | √ |
| No. Tel Pembekal |  |  |  | √ | √ |
| Tarikh Pasang |  |  |  | √ | √ |
| Tarikh Waranti Pembekal |  |  |  | √ | √ |

**DRAIN/CULVERT/SUMP/INLET/OUTLET**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Drainage: Drain/Culvert/Sump/Inlet/Outlet** | | | | | |
| **Parameter** | **Level of Development** | | | | |
| **Type** | **LOD 100** | **LOD 200** | **LOD 300** | **LOD 400** | **LOD 500** |
| Hyperlink |  |  |  |  |  |
| Katalog |  |  |  | √ | √ |
| Lukisan Terperinci |  |  |  | √ | √ |
| Noted |  |  |  |  |  |
| Jika Berkaitan |  |  |  |  |  |
| General |  |  |  |  |  |
| Jenis Binaan |  |  | √ | √ | √ |
| No Kod DAK |  |  |  | √ | √ |
| Nama Pembekal |  |  |  | √ | √ |
| No. Tel Pembekal |  |  |  | √ | √ |
| Tarikh Pasang |  |  |  | √ | √ |
| Tarikh Waranti Pembekal |  |  |  | √ | √ |

**PIPE/MANHOLE/PUMP STATION**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sewerage: Pipe/Manhole/Pump Station** | | | | | |
| **Parameter** | **Level of Development** | | | | |
| **Type** | **LOD 100** | **LOD 200** | **LOD 300** | **LOD 400** | **LOD 500** |
| Hyperlink |  |  |  |  |  |
| Katalog |  |  |  | √ | √ |
| Lukisan Terperinci |  |  |  | √ | √ |
| Noted |  |  |  |  |  |
| Jika Berkaitan |  |  |  |  |  |
| General |  |  |  |  |  |
| Jenis dan Material |  |  | √ | √ | √ |
| Saiz |  |  | √ | √ | √ |
| No Kod DAK |  |  |  | √ | √ |
| Nama Pembekal |  |  |  | √ | √ |
| No. Tel Pembekal |  |  |  | √ | √ |
| Tarikh Pasang |  |  |  | √ | √ |
| Tarikh Waranti Pembekal |  |  |  | √ | √ |

**PIPE/VALVE/FITTING**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Water Reticulation: Pipe/Valve/Fitting** | | | | | |
| **Parameter** | **Level of Development** | | | | |
| **Type** | **LOD 100** | **LOD 200** | **LOD 300** | **LOD 400** | **LOD 500** |
| Hyperlink |  |  |  |  |  |
| Katalog |  |  |  | √ | √ |
| Lukisan Terperinci |  |  |  | √ | √ |
| Noted |  |  |  |  |  |
| Jika Berkaitan |  |  |  |  |  |
| General |  |  |  |  |  |
| Jenis dan Material |  |  | √ | √ | √ |
| Saiz |  |  | √ | √ | √ |
| No Kod DAK |  |  |  | √ | √ |
| Nama Pembekal |  |  |  | √ | √ |
| No. Tel Pembekal |  |  |  | √ | √ |
| Tarikh Pasang |  |  |  | √ | √ |
| Tarikh Waranti Pembekal |  |  |  | √ | √ |