Substation Design Instruction

Access roads and driveways

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SDI 514 Access roads and driveways

Contents

1.0 PURPOSE

To set out in detail the minimum design, material and construction requirements for access roads and driveways in transmission/zone substations and switching stations.

2.0 SCOPE

This instruction defines the requirements for the design, material and construction of access roads and driveways in transmission/ zone substations and switching stations.

3.0 REFERENCES

- Company Policy 2.1 - Risk Management
- Company Policy 3.14 - Occupational Health and Safety Design Policy
- Company Policy 3.4 - Electrical Safety
- Company Policy 9.2.5 - Network Asset Design
- Company Policy 9.7.1 - Network Asset Construction
- Network Management Plan December 2013 Review
- Electrical Safety Rules
- Earthing Design Instruction EDI 516 - Major substation earthing design, construct and commissioning
- Substation Design Instruction SDI 505 - Minimum design and construction requirements for transmission and zone substations and switching stations
- SDI 524 - Fencing and perimeter security at zone and transmission substations, and switching stations
- SDI 527 - Clearances
- SDI 531- Installation of conduits in transmission/zone substations and switching stations
- SDI 532 - Plumbing and drainage
- Drawing no. 052751 - Zone substation 180mm reinforced concrete access road arrangement and detail
- Drawing no. 054495 - Gate latch recess former fabrication detail
- ENA National Electricity Network Safety Code (Doc 01-2008)
- *Work Health and Safety Act* 2011(NSW)
- AS 1012:2014 - Methods of testing concrete
- AS 1289:2000 - Methods of testing soil for engineering purposes- General requirements and list of methods
- AS 1348:2002 - Glossary of terms - Roads and traffic engineering
- AS 1379:2007 - Specification and supply of concrete
- AS1726:1993 – Geotechnical site investigations
- AS 2032:2006 - Installation of PVC pipe system
- AS 3600:2009 - Concrete Structures
- AS 3725:2007 - Design of installation for buried concrete pipes
- AS 3799:1998 - Liquid membrane - forming curing compound for concrete
- AS 3972:2010 – General purpose and Blended Cements
- AS/NZS 4671:2001 - Steel Reinforcing Materials
- HB 160:2006 - Soils testing
- NSW Roads and Traffic Authority parameters
- Local council guidelines
- RMS 3051 - RMS quality assurance specification - *Unbound and modified base and sub-base materials for surfaced road pavements*

4.0 DEFINITIONS AND ABBREVIATIONS

Atterberg Limits [1]	A set of arbitrarily defined boundary conditions in soil related to water content. These include liquid and plastic limits of soil.
Base course[1]	One or more layers of material usually constituting the uppermost structural element of a pavement and on which the surfacing may be placed, which may be composed of fine crushed rock, natural gravel, broken stone, stabilized material, asphalt or Portland cement concrete.
California bearing ratio (CBR)[2]	Load, expressed as a percentage of a standard load, required to penetrate a specimen of soil for a specified distance at a given rate. (The harder the surface, the higher the CBR rating).
Cement stabilization [1]	The controlled application of cement to improve the load-carrying capacity of a pavement layer (usually the base course) or of the sub grade.
Compression test	A test for determining the strength and elasticity of a material in compression, such as concrete, under specified test conditions.
Curing compound [1]	A substance sprayed and painted onto any concrete surface to retard loss of moisture during hardening.
DGB20	Densely graded base material nominally sized to 20mm. Conforming to RMS quality assurance specification 3051.
Divots	Small lumps of grass and earth accidentally dug out of the ground.
Driveway	A personal road that enables vehicles to travel from a public road to a substation vehicular gate.
Geotechnical [3]	Pertaining to the nature, condition and physical properties of the earth's crust (whether soil or rock and including water and gases therein) which affect its performance in civil engineering and building works.
Geotechnical site investigation [3]	The process of evaluating the geotechnical character of a site in the context of existing or proposed works or land usage.
Maximum modified dry density (MMDD) [1]	Dry density of soil obtained using a specified amount of compaction, when using a modified compactive effort, at the optimum moisture content.
NATA	National Association of Testing Authorities
Pavement [1]	That portion of a carriageway placed above the sub grade for the support of, and to form a running surface for vehicular traffic.
RMS	Roads and Maritime Services, NSW.
Slump [4]	A measure of the consistency of freshly mixed cement concrete, determined in accordance with standard test procedure. A slump test shows the workability of concrete, that is how easy the concrete can be placed, handled and compacted.

1 AS 1348 -2002: Glossary of Terms - Roads and traffic engineering
2 AS 1289 – 2000: Method of testing soils for engineering purposes – General requirement and list of methods
3 AS 1726 – 1993: Geotechnical site investigation
4 AS 1348 -2002: Glossary of Terms - Roads and traffic engineering

Shoulder [4]	The portion of the carriageway beyond the traffic lanes and adjoins and flushes with the surface of the pavement.
Sub base [4]	Material laid on the sub grade below a base course, for the purpose of making up additional pavement thickness required, to prevent intrusion of the sub grade into the base, or to provide a work platform. Sub-base is between the base course top layer and sub grade bottom layer.
Sub grade [4]	Trimmed or prepared portion of the soil formation on which the pavement is constructed. Generally, it relates to the upper line of the formation.
Wearing course	That part of the pavement upon which the traffic travels [4]. It is commonly made of asphaltic concrete base material. In certain cases, the concrete base itself could be used as wearing course.

5.0 ACTIONS

5.1 General

Access roads and driveways shall be designed to allow for easy access for construction and maintenance vehicles at all times. Access roads and driveways shall be designed in compliance with approved local council and RMS requirements, and as a minimum, to the guidelines set out in this instruction.

The dimensions and pavement thicknesses of the access road at the entry driveway and for the full length of the roadway shall be designed to provide easy transport, loading and unloading of the largest component (weight and dimensions) installed in the substation.

Usually, the largest component in a substation is a power transformer. However, there could be other components in a substation that may be heavier and wider than a power transformer. These values are site specific and shall be selected from profiles of vehicles, as applicable, for lifting and transportation.

Every effort must be made to design access roads with a turning bay to allow all vehicles to leave the substation in a forward direction. However, in cases where land acquired for construction of substations is insufficient, and a turning circle is not practically possible to construct, separate entry/exit points may be considered in substation driveway design.

If both of these options are not met, a dead end access road design may be adopted. If a dead end design is used, warning signs shall be affixed at the vehicle gate to warn drivers that there are no turning or drive through facilities for long vehicles within the substation.

Lengths and widths of sections of roadways used for loading/unloading of equipment, at locations such as loading docks or transformer bays, shall be adequately dimensioned and designed for loading/unloading.

5.2 Geotechnical site investigation and reporting

Geotechnical investigation shall be carried to obtain sufficient site information to decide on the technical feasibility and economics of proposed substation land site construction including the access roads. The geotechnical site investigation scope shall be as set out in AS 1726. Based on the guidelines in the standard, a geotechnical report shall be prepared by a qualified geotechnical engineer providing recommendations for all civil engineering and building works at site.

As a minimum the following shall be a part of the investigation:

- Evaluation of the geology and hydrogeology of the site;
- Examination of the existing site geotechnical and hydrogeology survey/report;

- Soil or rock sampling and testing;
- In situ assessment of geotechnical properties of materials;
- Contamination investigation of the site; and
- Reporting of the results.

5.3 Conduits and pipes

5.3.1 Cable conduits

Cable conduits shall be installed, as set out in SDI 531 - Installation of conduits in transmission/zone substations and switching stations, and Drawing no. 052751, prior to construction of the road. Where it is considered that conduits installed in trenches, under a driveway, may suffer damage from traffic conditions above them, additional mechanical protection shall be installed. In these cases, a protective layer of 15MPa concrete mix, with a minimum thickness of 75mm, shall be laid on top of the conduits.

5.3.2 Drainage and sewer pipes

Drainage and sewer pipes shall be located below the compacted sub grade. The compaction of subgrade shall be such that duct deformation does not occur under any condition. Minimum depth of pipes under the sub grade is normally assessed by type of soil, pipe material (concrete or PVC) and the likely vehicle loads. Concrete and PVC drainage pipe installation depths shall be as set out in AS/NZS 3725:2007 and AS/NZS 2032:2006 respectively.

5.4 Finished level and fall

The level of the finished access road, within the substation, shall be as close as possible to the floor level of the transformer bay. A transformer bund wall shall never be used as a retaining wall for road pavement and reserve shoulder loads.

As a minimum, access road surfaces shall have cross falls of approximately 2% or 60mm over any 3.0m of length (refer to Figure 1). Fall on road surfaces abutting transformer bunds shall be sufficient to enable the flow of water to be directed away from the bund wall towards the central drainage points located in middle of the road.

5.4.1 Storm water drainage

All access road and driveway storm water drainage shall be in accordance with council requirements, which will vary for each council. Where a council does not recommend any storm water drainage system, the preference shall be v-shaped design access road storm water drainage.

The drainage shall be adequately designed to meet minimum capacity of drainage to convey stormwater flow for a one in 20-year, 24-hour storm. The design shall cater for an adequate number of interconnected storm water pits for easy flow of rainwater from road surfaces runoffs (refer to Figure 1). For more details on stormwater drainage, refer to SDI 532 - Plumbing and drainage.

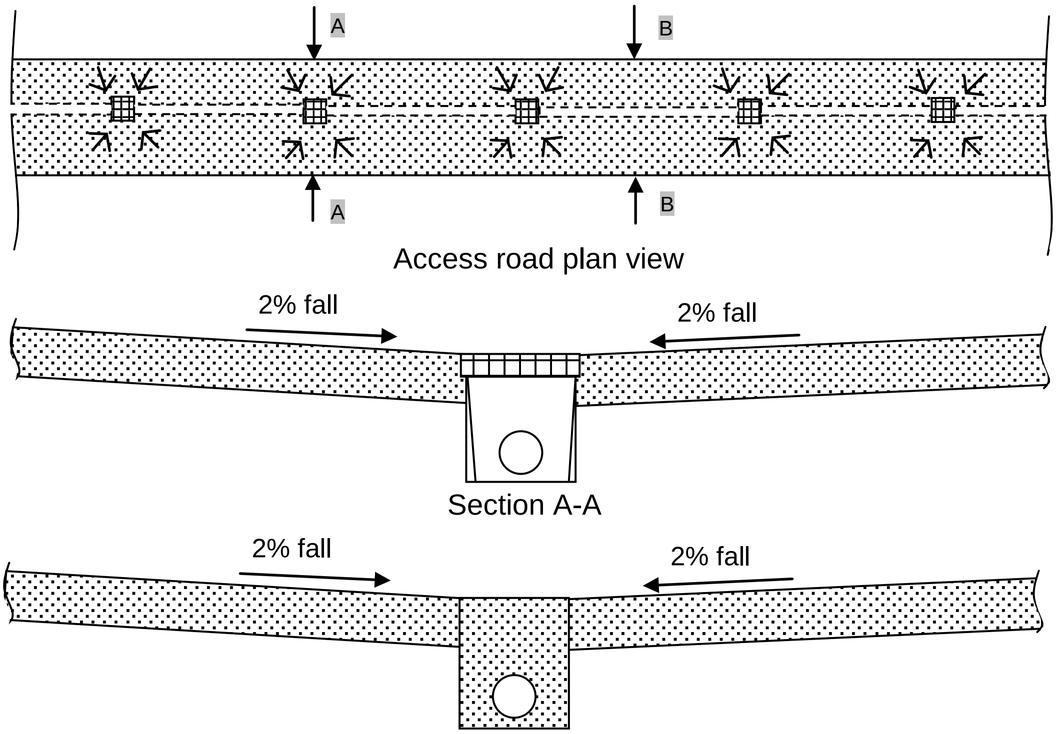

Figure 1: Typical access road drainage layout with interconnected stormwater drainage pits

5.5 Typical road design and construction details

The access road and driveway shall be designed and constructed in accordance with the minimum requirements, as recommended in this instruction and any special design requirements that may be considered necessary for incorporating into a particular project site or function or required to be included as a result of the site geotechnical investigation report.

5.5.1 Sub grade

The sub grade shall be firm, consistent and free from divots. A CBR value of less than 5 is **not** acceptable. The sub base and base course depth, thickness and materials used in the construction shall be utilised as recommended in the geotechnical site investigation reporting.

If the sub grade is of varying moisture content, and/or has areas of loose or varying consistency, the qualified geotechnical engineer shall be consulted and ways to improve soil condition shall be sought (refer to clause 5.7.1 for sub grade testing requirements).

Table 1: Minimum pavement design[5] for access roads

Sub grade **CBR** **%**	**Sub base** **(DGB20[6] to 98% MMDD)** **(Minimum thickness)** mm	**Base course** **Concrete (32 Mpa)** **with SL102 to AS 4671** **(Minimum thickness) mm** (see note 2)
Minimum 5 or higher as recommended by the geotechnical engineer	150	200
< 5	Not acceptable. Sub grade of less than 5 shall be improved as recommended by a geotechnical engineer.	

Note-1: The, quality and strength of sub base and sub grade shall be kept uniform including those covered under road shoulders

Note-2: The type of reinforcement used in the concrete base course shall be as recommended by the geotechnical engineer.

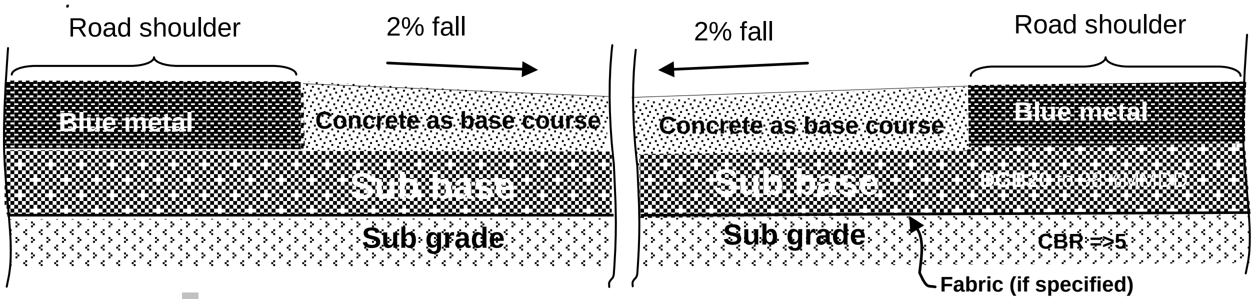

Figure 2: Cross section of typical general road layout with layers of sub grade, sub base, base or wearing course (reinforcements not shown)

5.5.2 Fabric

If a fabric cover is specified and recommended to be laid on the subgrade, one layer of *Polytrac* 155 Geotextile fabric (or similar) shall be used. Where there are joints, it shall overlap by 300mm on firm sub grades, or 600mm on loose sub grades.

5.5.3 Sub-base

The sub-base shall be formed using road base with a maximum aggregate size of 20mm (DGB20) to a minimum depth of 150mm. The road base shall be well consolidated and dampened with water prior to pouring of the kerb or concrete. Sub-base pavement compaction shall be made not less than 98% of MMDD.

5.5.4 Concrete (base course)

Concrete shall be used as a preferred base or wearing course, conforming to AS 3600 and AS 1379, and having a minimum compressive strength of 32MPa. Cement used in concrete shall be general purpose (GP), conforming to AS 3972. The size of aggregate used in concrete mix shall be not more than 20mm.

Concrete shall be continuously poured and vibrated using an immersion vibrator, and shall be finished by screeding, wood float; screeding, bull float; and, broom, in that order. Concrete depth shall be uniformly maintained.

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[5] *"Industrial floors and pavements - Guidelines for design, construction and specification", Cement and Concrete Association of Australia.*

[6] *20mm nominally sized densely graded base, conforming to RMS quality assurance specification 3051.*

5.5.5 Access road and driveway layback

All access road and driveway layback design and construction (including road reserve shoulder, if specified) shall be approved by the local council and conform to local council and RMS standards, falls and sealing. If specified and recommended in the geotechnical report (for flexible pavements only), a layback shall be constructed from AC10 as a wearing course over the sub-base DGB20.

5.5.6 Kerbs and gutters

Generally, kerbs and gutters are not required in access road design. However, where there is a need of vehicles to park on other side of the road or for drive through, kerb and gutter construction may be utilised. It shall be made of concrete, consisting of either continuous flow-form kerbing (*rolled kerb)* or square-form style. The flow-form can be contoured to any shape and does not require reinforcing (refer to Figures 3 and 4 below).

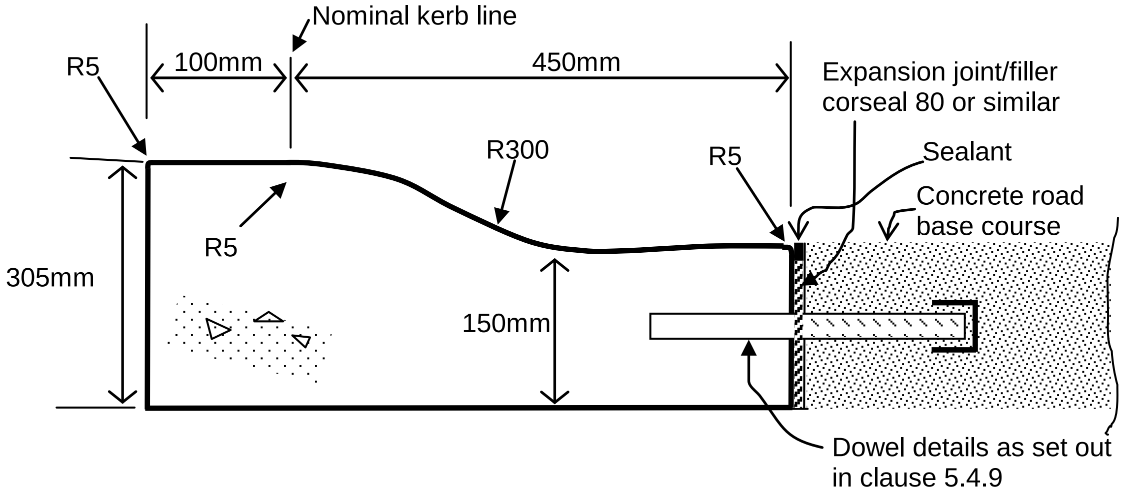


Figure 3: Cross-section of a typical construction of flow-form kerb and gutter style (reinforcing mesh not shown)

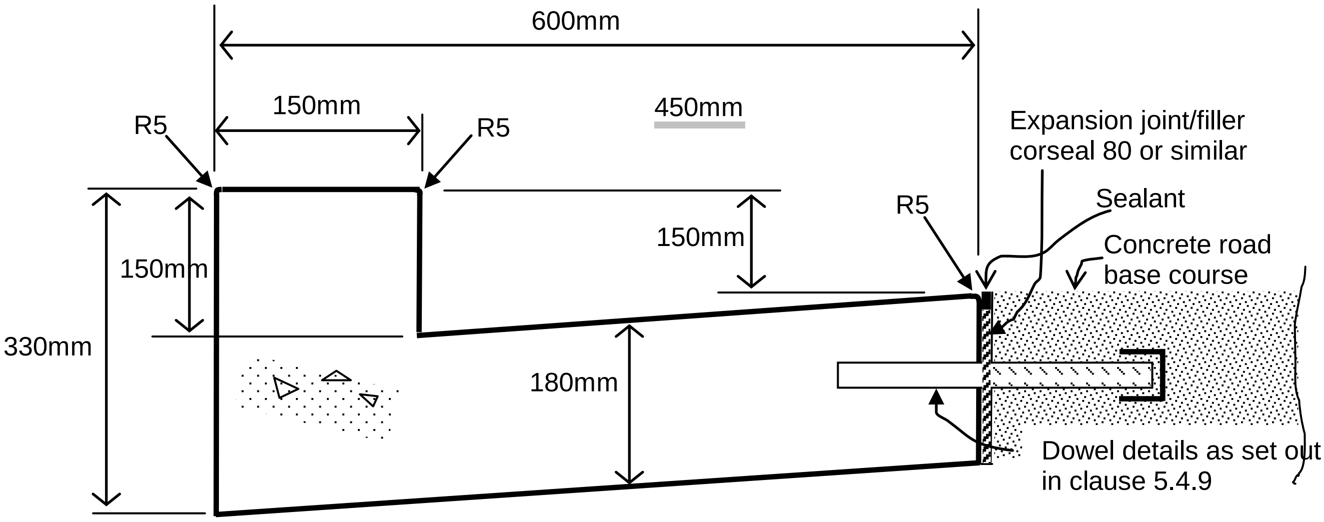


Figure 4: Cross section of a typical construction of square-form kerb and gutter style (reinforcing mesh not shown)

5.5.7 Road reserve shoulder

The road reserve shoulder may be specified in an access road design. Similar to sub base, the road reserve shoulder shall be constructed from grade of DGB20 compacted to 98% of MMDD. However, the depth shall be at least up to the depth of the sub base. The top surface gradient shall be not less than 1:6.

5.5.8 Steel reinforcing mesh

Type and size of steel reinforcing used in the concrete base shall be as recommended by the geotechnical engineer. The dimensioning of the reinforcing steel is usually by sheet size, the end laps and the side laps along adjoining sheets. The longitudinal outside wires are to be tied together at given centres. All steel reinforcements shall be made electrically continuous and bonded to the nearest main earth grid points (refer to EDI 516 - Major substation earthing design, construct and commissioning for minimum steel reinforcement to main earth grid earthing connection points).

The mesh shall have uniform concrete cover of 60 mm on top and 75 mm at the sides. The mesh shall be laid so that the longitudinal wires run along the length of the road, and the mesh shall be held in position while the concrete is being poured. The mesh shall be supported by plastic tipped chairs that are evenly spaced at 1000 mm centres: the spacing may be reduced if the mesh is to be heavily loaded during construction.

5.5.9 Dowels

Each section of concrete is joined to the next by the use of 20mm diameter shrink-wrapped hot dip galvanised steel dowels, which are 350mm long. The dowels are designed to expand and contract with no damage to the concrete. The dowels are usually tack welded to the mesh to prevent movement while pouring, and shall be located at 1m intervals. For a pavement having a thickness of 200mm or greater, use a 25mm diameter, 400mm long at 300mm centres dowels.

5.5.10 Grooves and expansion joints

Expansion joints shall be made and filled with 13mm wide, 51mm deep *Corseal 80* or similar material before pouring the concrete, or a groove may be cut within 36 hours of pouring the concrete and the filler located. The filler shall be sealed using a sealant to stop the ingress of moisture.

As a minimum, both the filler and sealant shall be in accordance with Cement and Concrete Association of Australia guidelines.

5.5.11 Curing of concrete

Cure all concrete as follows:

- Keep surfaces continuously wet for three days; then,
- Prevent moisture loss for next four days using polyethylene sheeting or wet hessian protected from wind and traffic after which allow gradual drying out.

Curing compounds may be used provided that they comply with AS 3799 and they do not affect floor finishes.

PVA-based curing compounds are not acceptable.

5.5.12 Entry access and driveway

Special attention must be paid to the interface between the council/RMS layback and the access entry and driveway to provide an easy access inside the substations for low loaders. When designing access entry and driveway, local council requirements for the council reserve area of the access road shall be obtained and incorporated into the access road design (refer clause 5.4.14 for more details).

As much as possible, the road gradient for full length of access road, including entry access and driveway, shall not be more than 1:15 or 3.9º.

5.5.13 Access road abutting power transformer oil containment bunds

5.5.13.1 Minimum road widths and pavement thickness:

Road widths for full length of access road section adjacent to a power transformer bund walls shall be as specified in subclauses 5.5.13.1 and 5.5.13.2. Pavement thicknesses of full length road section shall vary from the standard thicknesses mentioned in Table 1 above (refer to subclause 5.5.13.3).

5.5.13.2 Access road level at approximately same level as TX bund floor

In situations where the access road surface level is approximately at the same level as the power transformer bund floor levels, the access road width shall be of the standard road width of 5200 mm.

Minimum values and concepts given in Figure 5 and Table 2 respectively shall be applied. These minimum values are based on widths of cranes[7] with outriggers included and fully extended, comprising 10m in case of cranes used in transmission substations, and 8.6m in the case of zone substations.

A civil design engineer shall ascertain and recalculate access road widths if these crane widths are exceeded.

The road side base course abutting the bund wall shall comprise of blue metal as indicated. The blue metal, sub base and the sub grade shall be well compacted and designed to suit placement of outriggers of cranes. If required, the blue metal surface can be used for the oil water separator drainage.

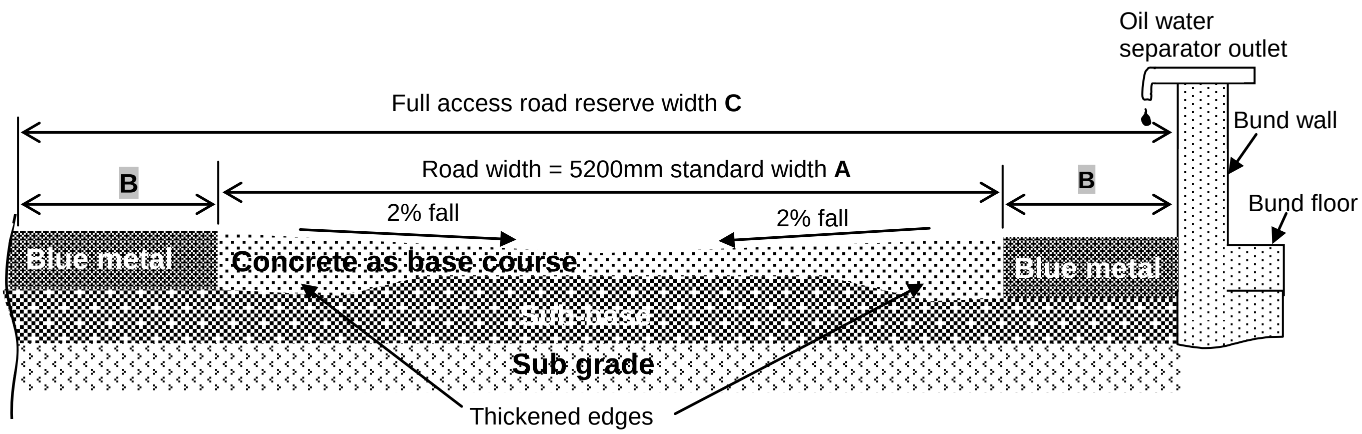


Figure 5: Sketch of cross section of typical road section abutting bund with same floor level (reinforcements not shown)

[7] Based on cranes of 200 and 400 tonnes capacities, with outriggers of 8.6 m and 10 m, for transmission and zone substation respectively. Refer Annexure 1 for details of crane dimensions and angles.

Table 2: Minimum access road width describing Figure 5

Substation	**Road standard width A (mm)**	**Road shoulder width B (mm)**	**Full access road reserve width C = A + 2xB (mm)**
Transmission substation	5200	2400	11000
Zone substation	5200	1900	9000

5.5.13.3 Access roads at higher level than TX bund floor (sunken TX bund designs) or building basement

In situations where the access roads surface level are higher than the power transformer bund floor levels (for sunken transformer bund design) or are constructed adjacent to building basement wall or a retaining wall, the concrete base course shall be laid up to the wall as indicated.

However, the full access road width shall include the standard road width of 5200mm, plus 2900mm for transmission substations and 1900mm for zone substations where the access road is constructed adjacent to sunken transformer bunds.

Minimum values and concepts for this arrangement, given in Figure 6 and Table 3 respectively, shall be applied.

In this arrangement a controlled application shall be adopted to improve on the load carrying capacity of the sub grade by using cement stabilisation back filling, as shown in Figure 6.

The cement stabilised backfill shall be of cement and sand mix with a ratio of 14:1, or as recommended by structural engineer. A perforated drainage pipe, as indicated, shall also be laid according to the recommendations of a structural engineer.

For side road surface drainage, include a dish drain, as indicated in Figure 6.

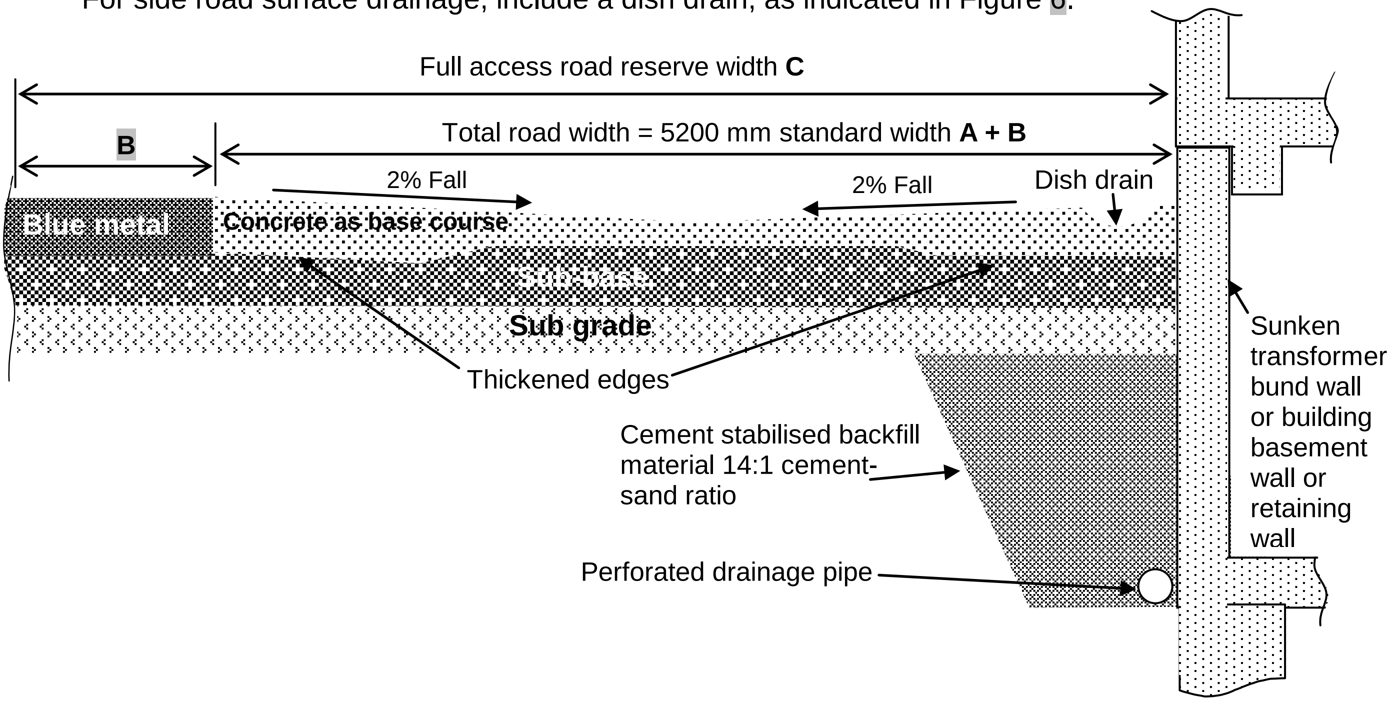


Figure 6: Sketch of cross section of typical section of access road at higher level than TX bund floor (sunken TX bund designs) or abutting building basement or a retaining wall (reinforcements not shown)

Table 3: Minimum access road width describing Figure 6 (differing levels)

Substation	Road standard width E (mm)	Road side width B (mm)	Full access road reserve width C = E + B (mm)
Transmission substation	5200 + 2900 = 8100	2900	11000
Zone substation	5200 + 1900 = 7100	1900	9000

5.5.13.4 Pavement thickness

Pavement thicknesses shall be calculated based on the weight of the most suitable vehicle required to carry, load/unload the heaviest equipment to be installed in a substation. Thickened edges, as shown in Figures 2 and 3, shall be included in access road designs. The design of thickened edges and overall pavement thickness shall be determined by a structural design engineer.

5.5.14 Road widths at entry access and driveway and height clearance guard

Road widths at entry access and driveway shall be based on profiles (sizes and capacities) of transportation vehicles expected for construction and maintenance works in the substation. Refer to Table 4 for typical examples of cranes.

The entry width **W** shall be designed to suit turning profiles and manoeuvring of the maximum size of vehicle, for instance, a low loader (refer to Figure 7).

The turning paths of the longest vehicle shall be calculated, keeping in mind the existing contours of the council road or street from where the access is permitted.

The carriageway width **F** (access road formation width) shall be **the standard 5.2m (minimum).** A clear gate opening on either side of the access road, between the gate post and the formation width edge, shall be maintained (refer to SDI 524 - Fencing and perimeter security at zone and transmission substations, and switching stations for standard gate widths).

The setback width **L** shall be adequately suited to turning and straightening up of a low loader before entering the gate.

The entry width **W** shall be designed in such a way that a low loader or long vehicle trail shall not encroach into any adjacent layback installations constructed along council reserve areas, especially at corners A and B shown in Figure 7 below.

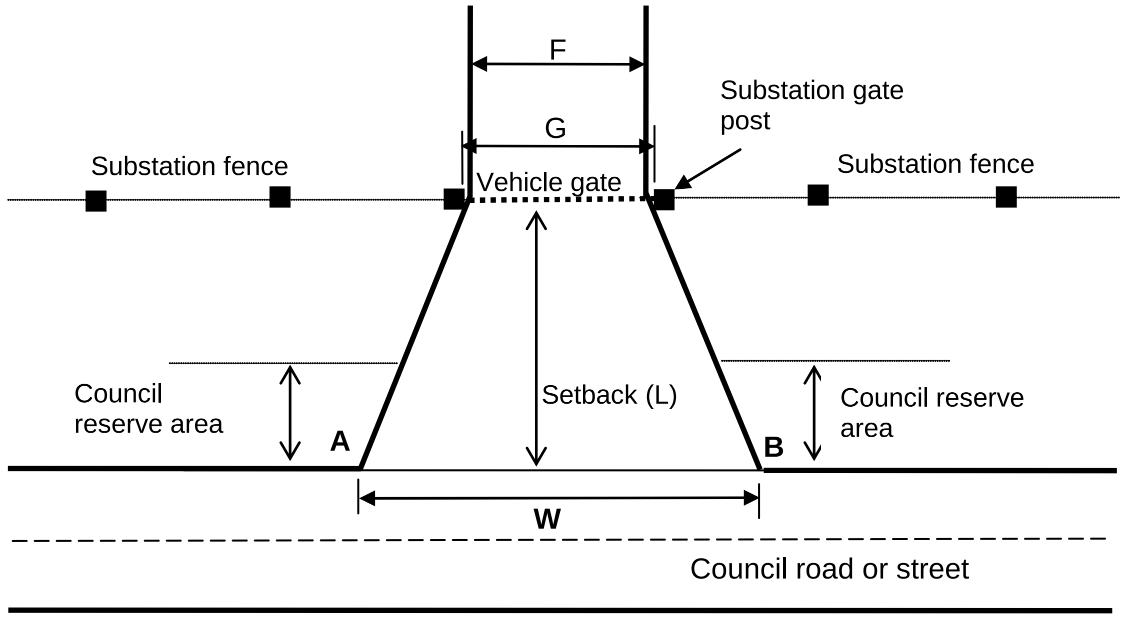


Figure 7: Sketch of typical entry access plan view

Refer to Table 4 below for examples of dead weight, maximum carrying capacities and corresponding, setback required (**L**), entry width (**W**), and carriage way **F** parameters.

Table 4: Examples of crane tonnage and drive/roadway dimensions

Crane		Drive and Roadway			
Dead weight Tonne	Maximum carrying capacity Tonne	Setback Required (L) m	Entry width (W) m	Carriage Way width (F) mm (for access roads) Refer section 5.5.14 Transmission Subs	 Zone Subs
40	100	13.5	23	11000	9000
80	150	13.5	23	11000	9000
120	200	13.5	23	11000	9000
160	250	13.5	23	11000	9000
200	300	13.5	23	11000	9000
240	350	13.5	23	11000	9000

In locations where power conductors cross over driveways, a suitable height clearance guard or bar for vehicles shall be installed/constructed at entry points. The height bars shall be heavy enough to cope with windy conditions, highly visible, and clearly displaying the maximum permissible clearance. SDI 527 - Clearances shall be referred for determining height clearances.

The construction of height bar structures shall allow for the top part to be removed for easy access of larger vehicles. The structure shall be constructed from galvanised steel and powder coated safety yellow.

5.5.15 Turning bulb (cul-de–sac) - optional

A 17.5m radius turning bulb (optional) with 150mm DGB20 (compacted to 98%MMDD) road base may be required for low loader (maximum of 10 axle Cometto) manoeuvring during the installation of transformers. The size of the turning bulb shall suit the required turning radius of a low loader that shall manoeuvre on the compacted base course.

However, care shall be taken by the contractor that manoeuvring should not take place if a rain event has occurred in the week leading up to positioning.

After installation of transformers, a smaller bulb (if specified) of 15m radius shall be constructed with rigid pavement to accommodate long-term loadings.

The pavement analysis for the bulb (If a turning bulb is feasible to construct in final designs) shall be based on the standard Endeavour Energy maintenance trucks with an additional safety factor of 1.5 safety margin. Refer Table 1 for minimum pavement design.

5.6 Gates and accessories

Gates will require a galvanised recess former (a long strip that can be easily cleaned out by wiping, rather than vertical tubes, which fill with dirt), located below the gates on the access road (refer to Drawing no. 054495 for recess former details).The recess former enables the gates to be shut, locked and held in position while closed.

The gates shall also have facilities so that they can be held in the open position. Some fences, such as chain wire, have their gate posts located on the kerb and gutter. Gates shall open inside the substation for full opening or clear gate openings for low loader manoeuvring (refer to SDI 524 - Fencing and perimeter security at zone and transmission substations, and switching stations). Ground level at the posts of the gates shall be set so that there is no ponding of water.

5.7 Sub grade and concrete testing

Sub-grade and concrete sampling shall be carried out by a qualified technician. The test samples shall be sent to a NATA approved testing laboratories only. The test results shall be approved by the geotechnical engineer or a civil engineer.

5.7.1 Sub grade testing

Before construction of access roads, sub grade bore samples shall be taken at intervals of 50m along the roadway surface (to a minimum depth of 500mm) to analyse and assess the quality of the sub grade. As a minimum, sub grade tests shall include the Atterberg limits (liquid and plastic limits - for classification of soil for moisture contents and plasticity) and CBR values (refer to clause 5.5.1 for acceptable CBR values).

For sub grade testing, refer to HB 160:2006 - *Soils testing*, and AS 1289:2000

5.7.2 Concrete testing

Compression and slump tests shall be carried out on freshly received batches of concrete, as set in AS 1012:2014.

As a minimum, four compression test cylinders of concrete shall be taken at the time of pouring. The concrete samples shall undergo compression and slump testing, after which test certificates shall be checked and confirmed, as set out in local council/ RMS guidelines.

6.0 AUTHORITIES AND RESPONSIBILITIES

Chief Engineer has the authority and responsibility for approving this instruction.

Manager Primary Systems has the authority and responsibility for making recommendations to the Chief Engineer in respect to this instruction.

Network Substations Manager, Primary Systems has the authority and responsibility for maintaining that the content of this instruction is kept up to date.

All **Endeavour Energy employees and/or contractors** have the authority and responsibility for:

- complying with the requirements of this instruction and SDI 505.
- working in accordance with local and statutory requirements.
- conforming with the safe design practices to manage public and worker safety; and
- working in accordance with Endeavour Energy's Electrical Safety Rules.

All **Project Managers** have the authority and responsibility for:

- complying with the requirements of this instruction within their area of responsibility;
- verifying that the Endeavour Energy employees and/or the contractors engaged to perform the work have appropriate qualifications; and
- entering appropriate equipment details into the Ellipse database as part of the work.

All **Regional Transmission Managers** are responsible for:

- complying with the requirements of this instruction.

All **Project Managers and Design Engineers** have the authority and responsibility for:

- designing access roads and driveways to comply with the relevant health and safety requirements for construction, operation and maintenance of the associated infrastructure;
- verifying that the Endeavour Energy employees and/or the contractors engaged to perform the work have appropriate qualifications;
- complying with the requirements of this instruction; and
- overseeing the work performed at site is carried out in accordance with local and statutory requirements.

7.0 DOCUMENT CONTROL

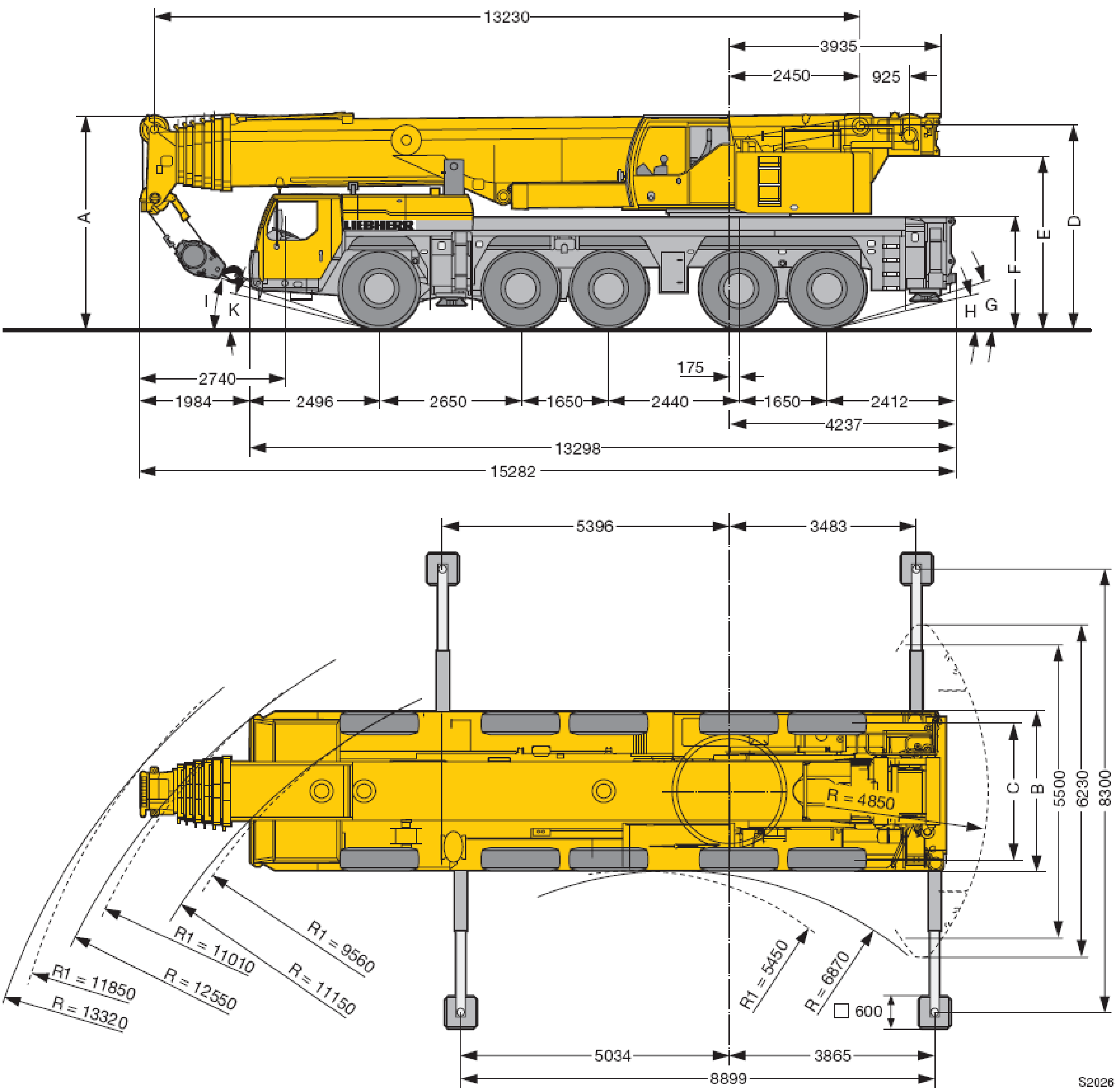
Documentation content coordinator: Network Substations Manager, Primary Systems

Documentation process coordinator: Standards Process Coordinator

Annexure 1: Kerb and guttering requirements (if specified and required in substation design).

EXAMPLE OF A 200 tonne crane [8]

- Maximum load capacity: 200 t
- Maximum height under hook: 98m
- Maximum radius: 82m



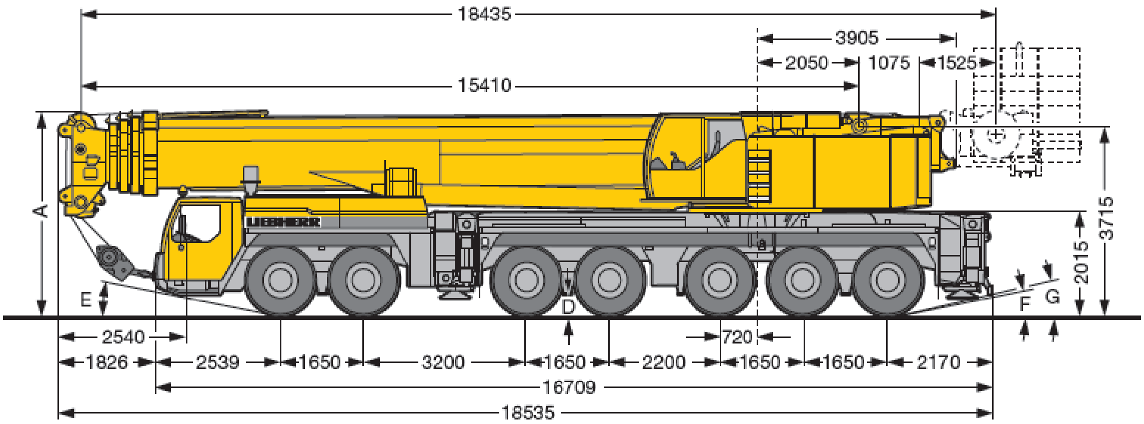
R1 = Allradlenkung · All-wheel steering · Direction toutes roues · Tutti gli assi sterzanti · Dirección en todos los ejes · Поворот всеми колесами

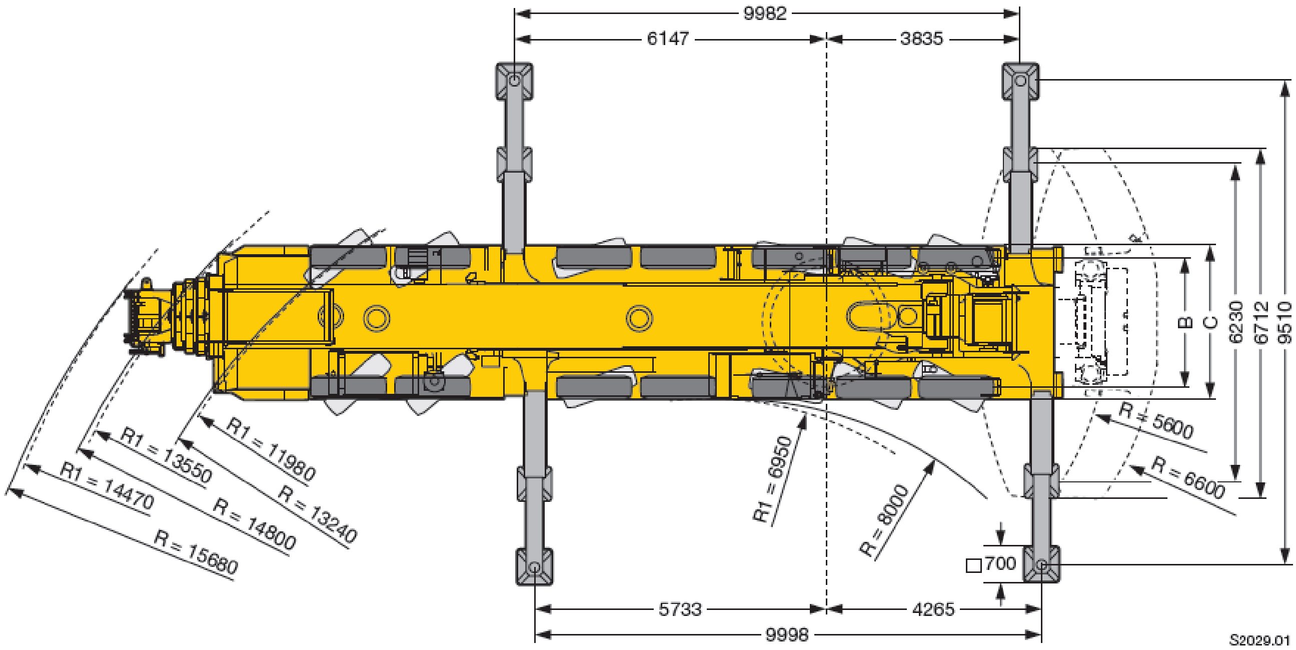
Maße · Dimensions · Encombrement · Dimensioni · Dimensiones · Размеры mm	A	A 150 mm*	B	C	D	E	F	G	H	I	K
385/95 R 25 (14.00 R 25)	3950	3800	3000	2563	3704	3139	2000	15°	12°	18°	14°
445/95 R 25 (16.00 R 25)	4000	3850	3000	2551	3754	3189	2050	17°	14°	20°	16°
525/80 R 25 (20.5 R 25)	4000	3850	3100	2573	3754	3189	2050	17°	14°	20°	16°

* abgesenkt · lowered · abaissé · abbassato · suspensión abaja · ...

8 Dimensions and angles of a 200 tonne LTM1200 - LIEBHERR

EXAMPLE OF 400 tonne crane [9]
Maximum load capacity: 400 t
Maximum height under hook: 130m
Maximum radius: 100m





	Maße · Dimensions · Encombrement · Dimensioni · Dimensiones · Размеры mm							
	A	A 150/100 mm*	B	C	D	E	F	G
385/95 R 25 (14.00 R 25)	4000	3850	2563	3000	350	12°	10°	11°
445/95 R 25 (16.00 R 25)	4000	3900	2551	3000	400	12°	10°	11°
525/80 R 25 (20.5 R 25)	4000	3900	2573	3100	400	12°	10°	11°

* abgesenkt · lowered · abaissé · abbassato · suspensión abajo · шасси осажено

9 Dimensions and angles of a 400 tonne LTM1400 - LIEBHERR