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The Design of Belt and Apron Feeders at a Coal Mine

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THE DESIGN OF BELT AND APRON FEEDERS AT A COAL MINE

1.0 SUMMARY

Operating conditions and client requirements require the use of large mass flow or expanded flow silos and bins in high capacity plants. Traditionally the load requirements of funnel flow bins and silos were less critical to material flow characteristics and accurate detail design, and some empirical formulae were used successfully. As the use of larger mass and expanded flow silos increased, the industry has learned quickly, mostly through bad experiences, that a more scientific approach to feeder and hopper design is essential.

2.0 INTRODUCTION

The object of this paper is to review

a) the design of a high capacity belt feeder system presently in operation at Grootegeluk I Coal Mine

b) the design of apron feeders at the new Grootegeluk II Coal Mine.

with emphasis placed on the design of a total integrated feeding system.

An attempt will be made to indicate the effect of factors, such as

- material characteristics,

- flow properties

- feed configurations, etc

on the design of feeders and a comparison of these designs to standard feeder calculations offered by suppliers in general to meet the requirements of a totally integrated system.

This paper is divided into two sections, namely

a) The design and operation of large capacity coal belt feeders at Grootegeluk for feed of coal to the Matimba Power Station and

b) The design of run-of-mine apron feeders for the new Grootegeluk II coal plant.

3.0 HIGH CAPACITY BELT FEEDER SYSTEM IN OPERATION TO FEED COAL TO MATIMBA POWER STATION

3.1 BACKGROUND

Iscor appointed the Consulting Engineering firm of Lategan, Smith and van der Linde Incorporated in 1982 for the design of the Matimba Power Station materials handling plant at Grootegeluk Coal Mine consisting of

- a multiple plant stockyard feed system

- a complete belt filter plant

- a three stream stockyard, each stream to be serviced by a 32 m boom travelling, luffing and slewing combination stacker/reclaimer, with a total live stockpile capacity of 750 000 ton, with stockpile dewatering facilities and blending capabilities

- automatic sampling plants before stacking

- automatic assizing and sampling facilities after stockpiling incorporating two 500 ton surge bin facilities

- complete 3 525 tph to 4 500 tph conveying system

At the same time the above Consulting firm was appointed by Escom for the design and contract management of the materials handling facilities between the mining plant described above and the power station incorporating:

- an approximate 4 000 m long overland 3 525 tph conveyor

- an operating and emergency stockyard with ancilliary conveyors and a 500 ton surge bunker facility.

Refer to overall flowsheet G0075004.

3.2 ASSIZING PLANT DESCRIPTION

After the 750 000 ton stockpile facility (before the 4 000 m long 3 525 tph overland conveyor) an automatic assizing/sampling facility, two 500 ton surge bins were installed for the following reasons:

- to provide surge capacity between the combination stacker/reclaimer with an output varying between 2 000 tph and 5 500 tph and the overland conveyor which must be evenly fed at a maximum rate of 3 525 tph

- to provide adequate surge to the Mine for emptying the reclaim conveyor system in case the feed system to the power station is out of operation, thus ensuring continuous stacking flexibility and maintenance availability of the reclaim system on the Mine.

- as a fixed operational/maintenance takeover point between the Mine and Escom.

- as a facility of payment/takeover between the two parties based on assized quantity and quality.

The plant consists of

a) a 2 100 mm wide feed conveyor

b) an automatic proportioning gate for feed to either of the two 500 ton bins

c) two 500 ton rectangular steel mass flow bins, with hopper angles at 21° and 16,4° to the vertical and lined with stainless steel SS304 liners. Each bin is provided with a belt feeder on the discharge and the complete system is supported on six 100 ton assizeable load cells. One bin is used for assizing purposes whilst the other bin is used as a surge facility only. The assized bin is provided with an automatic mass loading facility by means of 1 ton assized masses for calibration of the bin to its maximum capacity.

Signals from the load cells are used to

- control the feed out rate or
- to control the average reclaimer rate
- swing over the feed proportioning chute from the operating bin to the standby bin in case a high level is reached on the operating bin

d) An automatic sampling plant, operating on time or mass base for

- moisture
- physical
- chemical

analyses for samples to all parties involved.

Refer to layout and plant flow flowsheets G0076309, G0076937, G0076930. G0076933 and G0077794.

3.3 COAL DATA

Coal to be handled was analysed and tested to define the following properties:

Size:	: 35 mm
Total moisture content	: 5% to 18.4%
Bulk density	: 850 kg/m^3 to 980 kg/m^3 dry
Angle of repose	: 38° to 45°
Angle of withdrawal	: 45° to 52°

Angle of friction of coal to stainless steel SS304:

Moisture	**Angle ϕ**
18,4%	27°
13,4%	24°
7,95%	29° to 34°

Effective angle of internal friction δ

Moisture	Consolidated	δ
14%	0	6°
14%	4.8 kPa	5°

Hopper side wall angle: α = 21°
Hopper end wall angle : θ = 16.4°

The latter information was obtained from Jenike and Johansen, who were responsible for testing of the material flow properties of the coal.

3.4 BIN CONFIGURATION AND VERTICAL FEEDER LOADS

Due to the large percentage of fines in the material (70% minus 6 mm), the high moisture content and for assizing purposes, the bins must be totally self emptying, thus dictating a mass flow design for the bin and hopper.

For a meaningful design it is important to be able to determine with reasonable accuracy the loads acting on the bin, bin hopper and the feeder and the corresponding power requirements.

The majority of formulae published are empirical in nature and derived to predict loads and power requirements for feeders used in conjunction with funnel flow bins. These formulae are inadequate when applied to massflow bins, as the load and power requirements are often greatly underestimated.

This is largely due to the fact that in mass flow bins the full area of the hopper outlet is presented to the feeder.

The loads acting on feeders and corresponding power requirements are influenced by several factors. These include the following:

- Flow properties of the bulk solid
- The actual hopper geometry
- The wall friction characteristics between the bulk solid and hopper/skirt walls
- Hopper flow pattern, whether mass flow, funnel flow or expanded flow.
- The chosen hopper shape, i.e. axi-symmetric, conical or a combination.
- The type of feeder and its geometry
- The initial filling conditions when the bin is filled from the empty condition and the flow condition when discharge has occured.
- Super-imposed loading conditions on the feed material.
- Relative deflection between the bin/hopper and feeder under varying load conditions.

For a given bulk solid and hopper/feeder geometry, the load acting on a feeder varies considerably between the initial load, when the bin is first filled, and the load either during flow or after flow has stopped.

The method and procedure for estimating hopper and feeder loads has been established and viewed by A.W. Jenike, J.R. Johansen, A.W. Roberts, P.C. Arnold, A.G. MacLean and others. Using the above reference methods the vertical forces can be calculated.

3.4.1 Initial load condition

The normal wall pressure Pn is given by the Janssen equation:

Pn = Bin pressure plus initial surcharge pressure

$$= \frac{\gamma R}{\mu} \left(1 - e^{-\mu Kj\ h/R} \right) + Pno\ e^{-\mu Kj\ h/R}$$

and $Kj = Pn/Pv$

and $Pno = Kj\ \gamma\ hs$

thus

$$Pv = \frac{Qc}{Ac} = \frac{Pn}{Kj} = \frac{\gamma R}{\mu Kj} \left(1 - e^{-\mu Kjh/R} \right) + \gamma hse^{-\mu Kjh/R}$$

where

Pn = normal wall pressure
Pv = average vertical pressure
R = hydraulic radius
μ = coefficient of wall friction = tan
h = bin height
hs = effective surcharge
$hs = \frac{Hs}{m + 2}$

m = 0 for triangular surcharge
m = 1 conical surcharge
Hs = surcharge height
Kj = Pn/Pv
= 0,4 for slight convergences or
$= \frac{1 - \sin\delta}{1 + \sin\delta}$ with no convergences
Qc = Surcharge force at transition
Ac = area at transition

For the bin and hopper geometry and factors as per section 3.3. Qc/Ac varies from 51,69 kPa to 79,38 kPa.

To determine the load on the feeder an initial non-dimensional surcharge factor qi can be calculated, i.e.

$$qi = \left(\frac{\pi}{2}\right)^m \frac{1}{2(m+1)\tan\alpha}\left[D/_B + \frac{2Qc}{Ac\,\gamma}\frac{\tan\alpha}{D} - 1\right]$$

Where m = 0 for plane flow
m = 1 for axi-symmetric flow
B = hopper opening width
D = bin width

and the total initial belt feeder vertical load Qi is equal to

$$Qi = qi\gamma LB^2 \quad (kN)$$

where L = hopper opening length

For the different factors and hopper outlet geometry the calculated results are as follows:

Qi max = 440,5 kN with qi = 8,537
Qi min = 342,4 kN with qi = 8,357

3.4.2 Flow conditions

In the flow condition where the vertical support is removed, the major principal pressure acts more in the horizontal direction in the arched stress field above the feeder. Theoretical calculation for establishing the non-dimensional flow factor qf are as follows:

$$\beta = \tfrac{1}{2}\left(\phi + \mathrm{Sin}^{-1}\frac{\mathrm{Sin}\,\phi}{\mathrm{Sin}\,\delta}\right)$$

$$X = \frac{2^m\,\mathrm{Sin}\,\delta}{1-\mathrm{Sin}\,\delta}\left[\frac{\mathrm{Sin}\,(2\beta+\alpha)}{\mathrm{Sin}\,\alpha}+1\right]$$

$$Y = \frac{[2\,(1-\mathrm{Cos}(\beta+\alpha)]^m\,(\beta+\alpha)^{1-m}\,\mathrm{Sin}\,\alpha + \mathrm{Sin}\,\beta\ \mathrm{Sin}^{1+m}(\beta+\alpha)}{(1-\mathrm{Sin}\,\delta)\ \mathrm{Sin}^{2+m}(\beta+\alpha)}$$

and

$$qf = {}^{1}/4\,(\pi/3)^m\,\frac{1}{\tan\alpha}\left[\frac{Y}{X-1}\left(\frac{1+\mathrm{Sin}\,\delta\,\mathrm{Cos}\,2\beta}{\mathrm{Sin}\,\alpha}\right)(\tan\alpha+\tan\theta) - \frac{1}{1+m}\right]$$

and

$$Qf = qf\gamma LB^2\ \mathrm{kN}$$

The calculated values for Qf are as follows:

Qf max = 64,99 kN

Qf min = 36,096 kN

3.4.3 Comparison of theoretical and empirical calculations

Empirical formulae used for comparison are as follows:

- **Reisner's Method**

$$\frac{Tw}{\gamma B} = \frac{Y(1 + \sin\delta \ \cos 2\beta)}{2(X - 1)\ \sin}$$

and

$$Qf = Tw \times \text{hopper outlet area}$$
$$= Tw \times L \times B$$

- **Bruff's Method**

$$Q = \frac{2L^2 B^2 \ \gamma}{L + B} Ns \quad \text{(slotted outlet including end effects)}$$

Where $Ns = 4$ for initial filling condition

$Ns = 1$ for flow conditions

- **Johanson's Method**

$$Qf = \gamma L B^2$$

3.4.4 Jenike and Johansen

Jenike and Johansen use the non-dimensional q factor for the initial and flow conditions as calculated and multiplied by the mean outlet area and a dimensionless factor which depends on the loading condition, surcharge loads and method of feeder support to determine the total shear load.

A comparison between the empirical and theoretical calculations for the belt feeder are as follows:

Initial filling condition (filled from empty, inelastic support)

Method:	VERTICAL FORCE Qi (kN)	
	Maximum	Minimum
Theoretical calculation	440,50	342,40
Bruff method	338,40	268,72
Jenike and Johansens method	546,79	424,84
Reisner	181,64	109,24

Flow conditions:

	VERTICAL FORCE Qf (kN)	
	Maximum	Minimum
Theoretical	64,99	36,096
Reisner's method	45,41	27.31
Bruff's method	84,60	67,18
Johanson's method	51,60	40,98
Jenike and Johansen	65,66	37.19

3.4.5 Shear load due to vertical loads

The shear load acting on the belt feeder

$Qs = \mu Q$

where $\mu = \text{Sin}\ \delta$

In the initial filling condition

$Qsi = \text{Sin}\ \delta\ Qi$

and for flow conditions

$Qsf = \text{Sin}\ \delta\ Qf$

However, due to the fact that stainless steel SS304 liners were installed on the outlet as well as the fact that a profiled outlet were installed (also to ensure even withdrawal of coal from the bin - refer to drawing G0076981) it was recommended by Jenike and Johansen to use μ = 0,391 and μ = 0,796 for initial and flow conditions respectively.

The resulting material shear loads, are then

Qsi = 213,951 kN
Qsf = 52,292 kN

3.4.6 <u>Skirt plate friction</u>

Skirt plate friction will occur in 2 areas, namely

a) Skirt plates under the hopper which will be exposed to the bin vertical force

then

$$Fskh = \mu_2 Kv \ (2Q + \rho \ gBLy)y/B$$

and

b) Skirt plates outside the hopper area where

$$Fske = \mu_2 Kv \ \rho g \ (Ls - L)y^2$$

where

μ_2 = skirt plate friction co-efficient
Kv = 0,4
B = width between skirt plates
L = skirt length under hopper

Ls = total skirt length

ρ = bulk density

Q = initial filling or flow force under hopper

y = average height of material against skirt plates

The calculated values of the total skirt plate friction are as follows:

Initial filling:

Fsi = Fskh + Fske
= 23,78 + 0,489
= 24,269 kN

Flow condition:

Fsf = Fskh + Fski
= 3,24 + 0,328
= 3,568 kN

3.4.7 Conveyor forces

Conveyor forces were calculated according to ISO 5048 and resulted in an additional load of 33,979 kN for conveying the material, special and secondary forces as defined.

3.4.8 Total belt feeder forces

Total belt feeder forces Te is equal to

- Shear load out of hopper plus

- Total skirt plate friction, plus
- Conveyor forces

and resulted in an initial horizontal load of 272,199 kN and a horizontal load under flow conditions of 89,839 kN.

3.5 DESCRIPTION OF BELT FEEDERS

The belt feeders are as outlined in drawing G0076302.

3.5.1 General

The belt feeders are hydraulically driven, each capable of delivering coal at a rate of between 760 tph and 3 800 tph to the power station. Each belt feeder has 7 410 mm pulley centres, equipped with a 3 000 mm wide fabric belt and operating between 0,15 m/s and 0,75 m/s. Each conveyor is provided with a special screw take-up with a 1 000 mm travel and adjustment by hydraulic jack.

3.5.2 Hopper and skirt plates

The feed hopper outlet commenced with a width of 600 mm at the back and tapers open to 1 040 mm at the outlet. Vertically the hopper outlet starts at 25 mm above the belt line and is profiled to a final bed depth of 785mm at the outlet. The complete hopper outlet is lined with 20 mm thick SS304 stainless steel liners. The shear plow at the hopper outlet is constructed in 27% high carbon chrome casting.

The skirt plates are 6 539 mm long, tapered from 2 000 mm inside steel at the back to 2 300 mm wide inside steel at the centreline of the head pulley. is 390 mm high and is lined with 20 mm thick stainless steel liners.

To the outside of the steel skirt plate a rubber skirt is installed to prevent spillage of fine coal in case of a wash down in the bin due to the high moisture content in the coal.

3.5.3 Belting

A 3 000 mm wide belt (two 1 500 mm wide belt longitudinally spliced together) were used with a maximum operating tension of 584 kN in the belt. The belt is a fabric belt, 6 ply, with 25 mm top cover and 5 mm bottom cover class 2500.

3.5.4 Pulleys

Pulleys are 1 400 mm diameter, lagged with 3 980 mm bearing centres and 380 mm bearing shaft diameter.

3.5.5 Idlers

Each set of idlers consists of 3 flat in-line rolls with a 20° trough idler at each end. Troughing idler spacing is at 480 mm centres and two of these idler sets were used on the return side installed invertedly for training. Each idler frame is installed on stools at both sides for removal by overhead crawl. The total load per idler amounted to 55,3 kN and a special design for the 075 mm face width idler was required. The roll diameter of the idler was selected as 230 mm, with an 80 mm shaft fitted with spherical roller bearings.

3.5.6 Drive

The required power and torque for the drive was as follows:

For normal running:

Power	=	89,839 x 0,75 m/s
	=	67,38 kW
Torque requirements	=	89,839 x 0,707
	=	63516 Nm

For start-up based on a belt speed of 0,2 m/s

Power	=	272,19 x 0,2
	=	54,438 kW
Torque	=	272,19 x 0,707
	=	192438 Nm

If an electrical drive were selected an equivlent motor size of

$$\frac{63516 \times 1500}{95 \times 9550} = 105 \text{ kW for normal running}$$

and

$$\frac{192438 \times 1500}{95 \times 9550 \times 1,4} = 227 \text{ kW for start-up}$$

A 95:1 reduction ratio and 1,4 start-up factor was required. Because of the torque requirements, and based on prices obtained for variable electrical drives and hydraulic drives, it was decided to use hydraulic system for each drive. Two power packs, each consisting of 4 x 45 kW drives (identical to power packs already available on the Mine) were used. A single Flender hydraulic motor with a planetary drive, torque arm mounted on each belt feeder and operating at a maximum pressure of 14,5 mPa is used.

Facilities are provided for reducing the number of power packs once the belt feeder is started-up and feeding at a constant rate.

3.6 RESULTS

After operation of approximately 18 months no problems were experienced on site with the belt feeders. Initial measurements indicated that power and torque requirements were within 70 to 90% of the calculated design values for normal running condition. Measurement of the values for the initial condition is obviously very difficult if not impossible.

4.0 DESIGN OF SILO APRON FEEDERS AT NEW GROOTEGELUK II COAL PLANT

4.1 INTRODUCTION

In this section the importance of material tests and proper designs based on the test results will be illustrated by means of practical examples as experienced on this mine.

At the present plant three series of silo systems are currently in use, of which the design was based on material test results. One of these systems is operating successfully. The other two systems were designed with an interface between two contractors at the silo hopper outlets, and not as integrated systems. These two systems do not operate satisfactorily in spite of the fact that funnel flow silos are used with relatively low feeder loads. The drives and the feeders proved to be incapable of handling the required loads, and spile bars are permanently installed in selective areas to allow operation.

Due to the above experiences the client was easily convinced that material tests and an integrated designed system was required for the following reasons:

- Prevention of failure of silos and hoppers due to collapsing of unstable arches after ratholing as experienced on the same plant.

- Proper operation of adequately sized hopper and feeder configurations.

- To ensure the most practical and economical design for the silos, hoppers and feeders in determining the type of silo, i.e. mass flow, funnel flow or expanded flow, as well as the type of feeder to be used.

4.2 BACKGROUND

Material is fed from the mine through a rotary breaker plant, breaking the coal to -150 mm and discarding the waste lumps. The material is then screened at 25/35 mm before being fed into the heavy medium cyclone and vessel plant storage silos. The screen oversize material is stored in three 4 000 ton silos before being fed to the heavy medium vessel plant, and the undersize is stored in five 2 000 ton silos before feeding the heavy medium cyclone plant.

4.3 DESIGN

4.3.1 Introduction

The material flow properties, hopper angles and wall loads were determined by Jenike and Johansen. The preliminary test results were used to execute feasibility studies regarding the silo and feeder types and define the design requirements of the feeders, based also on the experience on the other feeders.

4.3.2 Silo Configuration

Expanded flow silos were selected above mass flow silos on cost, while funnel flow silos were rejected due to the increased material segregation.

Although the client initially envisaged apron feeders underneath the vessel plant silos, and belt feeders underneath the cyclone plant silos, the high calculated feeder loads proved the belt feeders more costly, and apron feeders were used in both cases, which illustrates the importance of preliminary design in finalising the concepts.

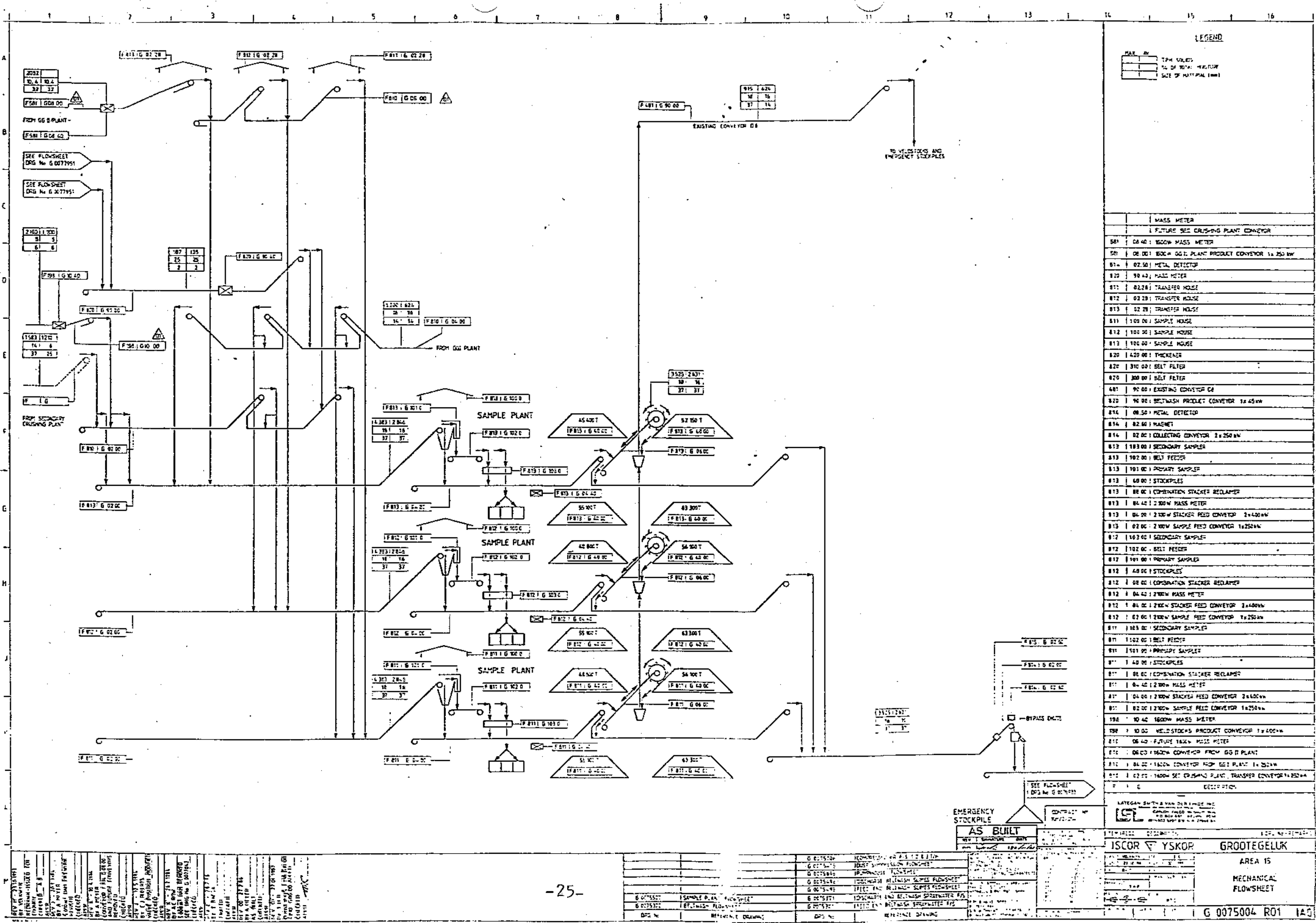
4.3.3 Feeder Selection

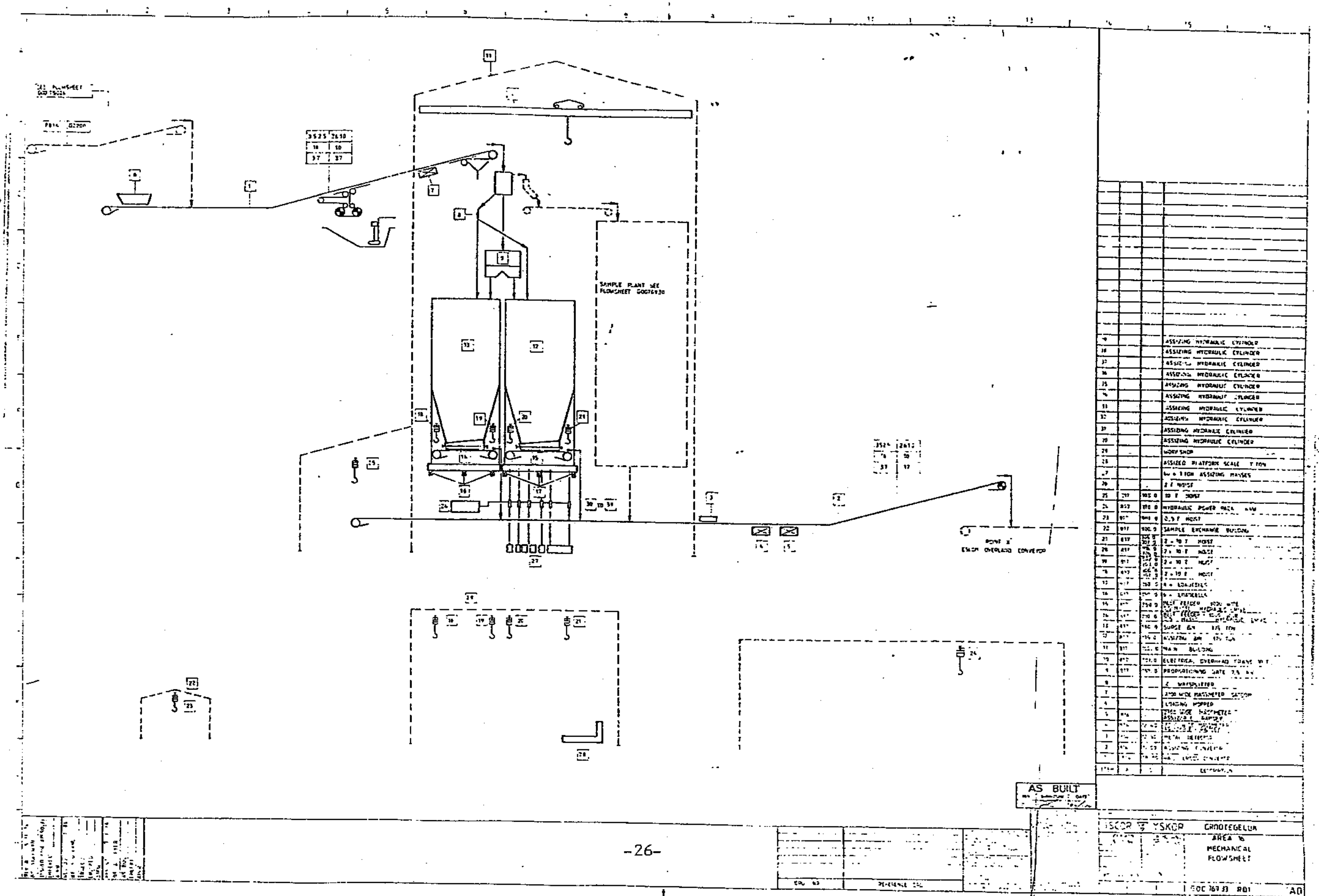
A comparison of the feeder loads, calculated as in section 3, with that of some of the tenderers who wished to ignore the specified loads, is given in the table below:

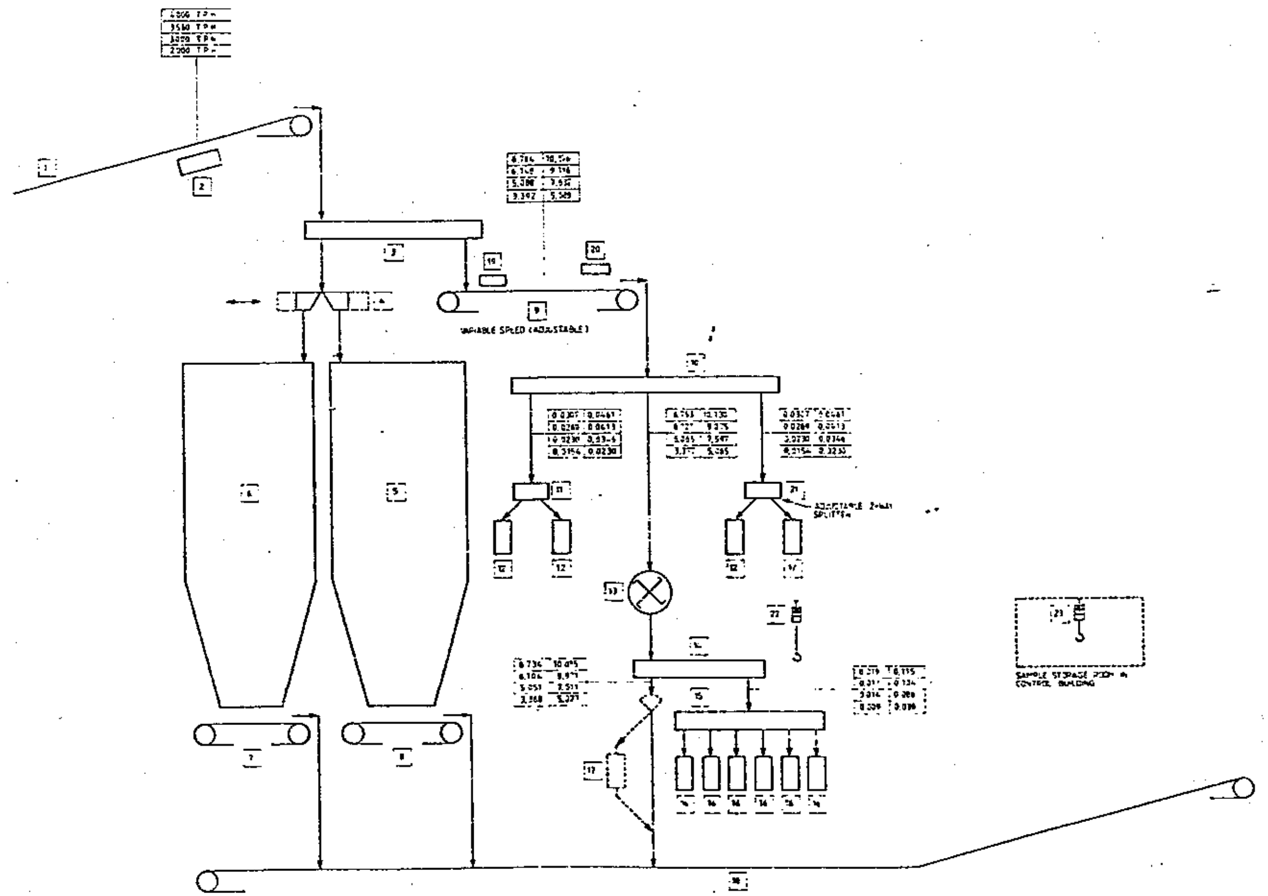
COMPARISON OF TOTAL HORIZONTAL FEEDER LOADS				
	GROUP 1 SILOS		GROUP 2 SILOS	
CONDITION	INITIAL (kN)	FLOW (kN)	INITIAL (kN)	FLOW (kN)
Specified Loads	451	132	300	86
Tenderer A	153	183	107	104
Tenderer B	169	112	114	76
Tenderer C	301	109	288	53
Tenderer D	62	55	56	16

The same sizes and capacities for these feeders, as well as drawings of the silo and hopper configurations were given to all the tenderers. The loads given by the tenderers were based on their own methods of calculation, using empirical formulae ignoring flow conditions, hopper geometry and surcharge pressures. The variance in these results indicates the high risk inherant in emperical feeder design methods which would appear to relate to only specific operating situations but applied on a general basis. Should the end user of the equipment be solely motivated to select on the basis of lowest capital cost and validity of any guarantee, it is likely that he will select a feeder which will not do the duty.

After detailed discussions with the tenderers, their offers were revised to comply with the specified loads, which were accepted by them in most cases.


LEGEND
T/H SOLIDS
% OF TOTAL MOISTURE
SIZE OF MATERIAL (mm)
FROM GG II PLANT
SEE FLOWSHEET DRG No G 0077951
FROM SECONDARY CRUSHING PLANT
FROM GGI PLANT
EXISTING CONVEYOR G8
TO VELDSTOCKS AND EMERGENCY STOCKPILES
SAMPLE PLANT
SAMPLE PLANT
SAMPLE PLANT
BYPASS CHUTE
EMERGENCY STOCKPILE
AS BUILT
MASS METER
FUTURE SEC CRUSHING PLANT CONVEYOR
1600W MASS METER
METAL DETECTOR
MASS METER
TRANSFER HOUSE
SAMPLE HOUSE
THICKENER
BELT FILTER
EXISTING CONVEYOR G8
BELTWASH PRODUCT CONVEYOR 1x45kW
MAGNET
COLLECTING CONVEYOR 2x250kW
SECONDARY SAMPLER
BELT FEEDER
PRIMARY SAMPLER
STOCKPILES
COMBINATION STACKER RECLAIMER
2100W MASS METER
2100W STACKER FEED CONVEYOR 2x400kW
2100W SAMPLE FEED CONVEYOR 1x250kW
1600W MASS METER
VELDSTOCKS PRODUCT CONVEYOR 1x400kW
FUTURE 1600W MASS METER
1600W CONVEYOR FROM GG II PLANT
DESCRIPTION
LATEGAN SMITH & VAN DER LINDE INC
ISCOR YSKOR
GROOTEGELUK
AREA 15
MECHANICAL FLOWSHEET
G 0075004 R01


SAMPLE PLANT SEE FLOWSHEET GOO76930
POINT X
ESKOM OVERLAND CONVEYOR
ASSIZING HYDRAULIC CYLINDER
WORKSHOP
ASSIZED PLATFORM SCALE
SAMPLE EXCHANGE BUILDING
HYDRAULIC POWER PACK
SURGE BIN
MAIN BUILDING
ELECTRICAL OVERHEAD TRANS
PROPORTIONING GATE
LOADING HOPPER
METAL DETECTOR
AS BUILT
ISCOR YSKOR
GROOTEGELUK
AREA 16
MECHANICAL
FLOWSHEET
A0



PRIMARY SAMPLER (ITEM 3)

SECONDARY MOISTURE SAMPLER (ITEM 10)

SECONDARY MOISTURE SAMPLE DISTRIBUTORS (ITEM 11)

TERTIARY SAMPLER FOR GENERAL ANALYSIS (ITEM 14)

GENERAL ANALYSIS SAMPLE DISTRIBUTOR (ITEM 15)

SAMPLE CRUSHER (ITEM 13)

LEGEND

MIN TPH	MAX TPH

AS BUILT

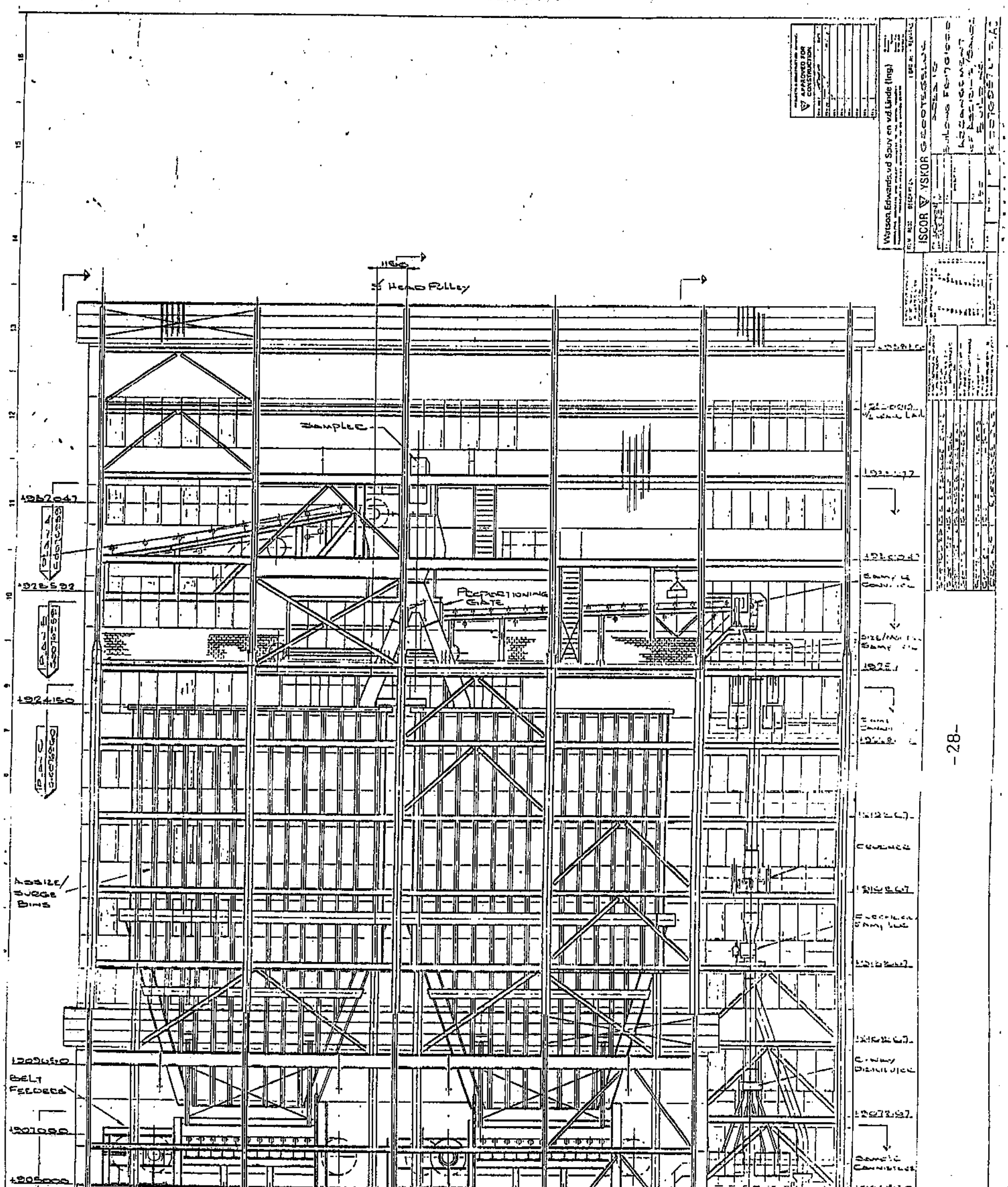
Watson, Edwards, v.d. Spuy en v.d. Linde (Ing)

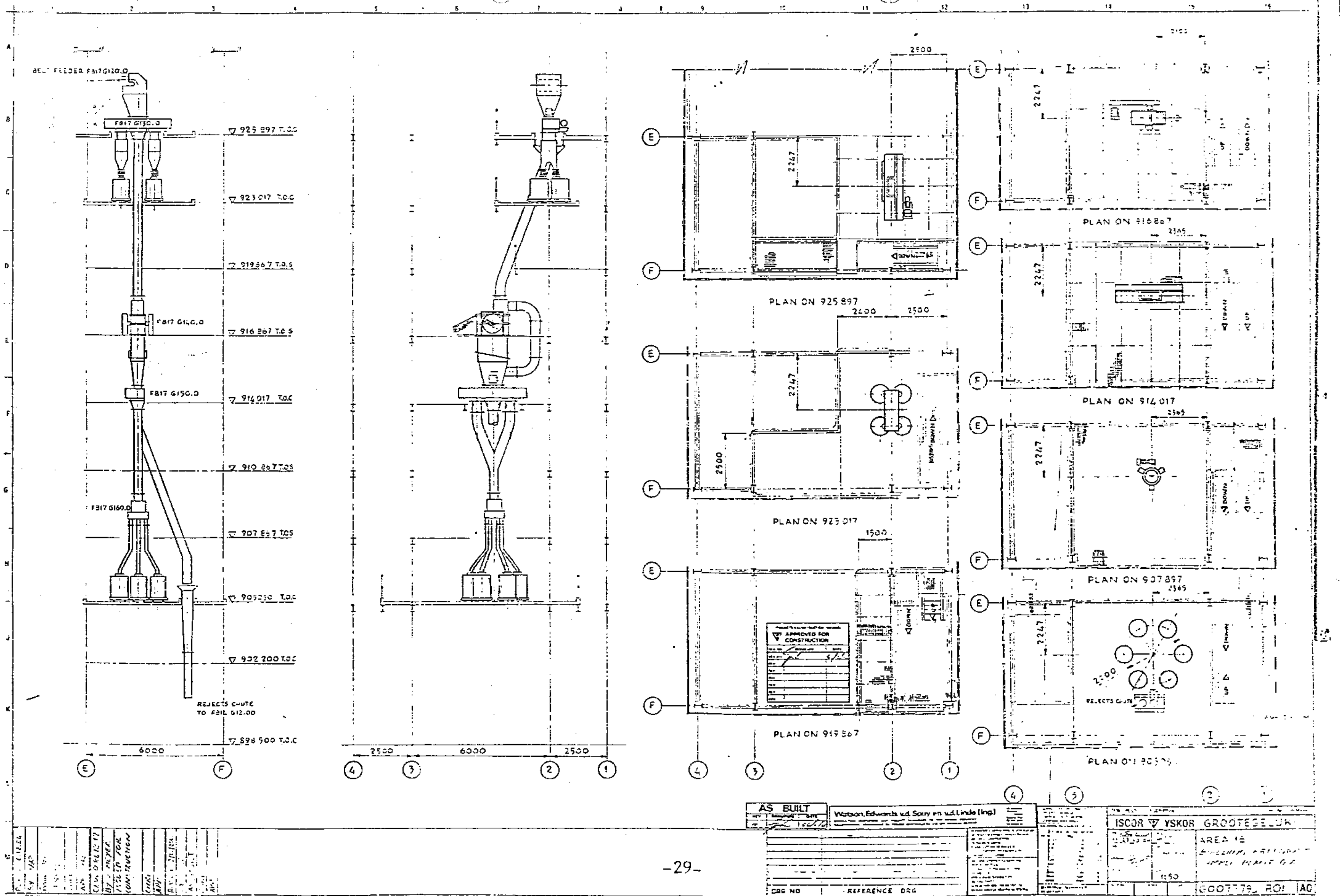
ISCOR YSKOR GROOTEGELUK

AREA 16

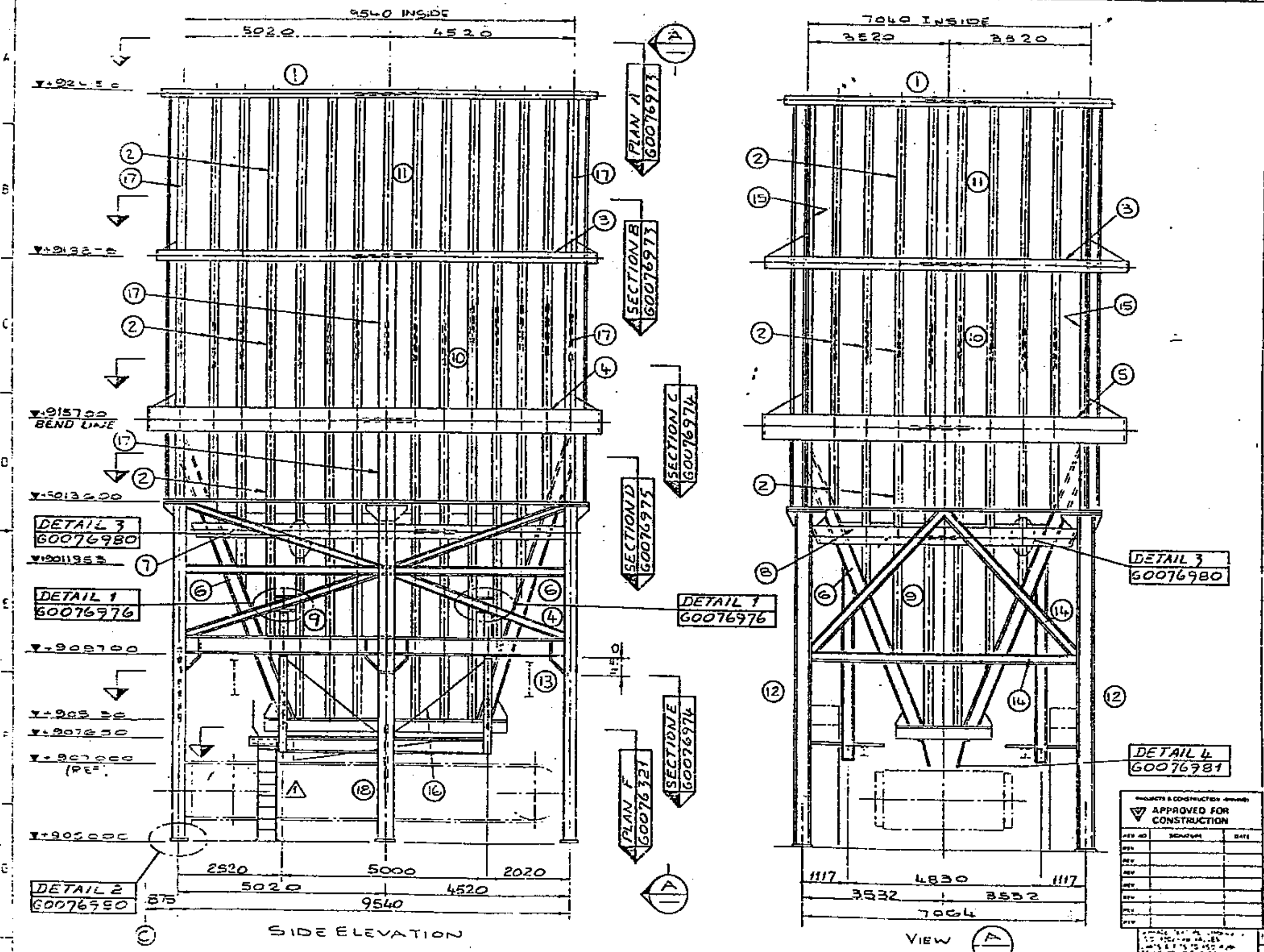
SAMPLE PLANT FLOWSHEET

G 0076930 R01 A0


Watson, Edwards, vd Spuy en vd Linde (Ing)
ISCOR YSKOR
APPROVED FOR CONSTRUCTION
HEAD PULLEY
SAMPLER
PROPORTIONING GATE
BELT FEEDERS
LOAD CELLS
VIEW G
SECTION E
SAMPLE PLANT AREA
6354
6000



BELT FEEDER F817G120.0
F817 G130.0
925 897 T.O.C
923 017 T.O.C
919 867 T.O.S
F817 G140.0
916 867 T.O.S
F817 G150.0
914 017 T.O.C
910 867 T.O.S
F817 G160.0
907 857 T.O.S
905 250 T.O.C
902 200 T.O.C
REJECTS CHUTE TO F81L G12.00
898 500 T.O.C
6000
2500
2500
2247
2600
2500
1500
2365
PLAN ON 925 897
PLAN ON 923 017
PLAN ON 919 867
PLAN ON 916 867
PLAN ON 914 017
PLAN ON 907 897
APPROVED FOR CONSTRUCTION
REJECTS CHUTE
AS BUILT
Watson, Edwards v.d. Spuy en v.d. Linde (Ing)
DRG NO
REFERENCE DRG
ISCOR YSKOR GROOTEGELUK
AREA 16
1:50
G007779 R01 A0
ISSUED FOR CONSTRUCTION



PLATEWORK GENERAL NOTES

1. PLATEWORK TO BE OF WELDED CONSTRUCTION 6 mm CONTINUOUS FILLET WELD U.O.S.
2. PLATE THICKNESS AND MATERIAL TO BE AS PROJECT SPECIFICATION.
3. ALL DIMENSIONS TO INSIDE OF PLATE U.O.S.
4. FLANGES TO BE —— U.O.S.
5. STIFFENERS TO BE —— FLAT U.O.S.
6. SUPPORT BRACKETS FROM —— PLATE U.O.S.
7. ALL HOLES TO BE 22ϕ FOR M20 BOLTS, ON STANDARD 6M U.O.S.
8. LENGTH OF SLOTTED HOLES DIMENSIONED ON DRAWING TO BE TOTAL LENGTH OF SLOT.
9. ERECTION BOLTS, NUTS AND WASHERS TO BE PLACED IN HESSIAN BAGS AND LABELLED CLEARLY WITH THE ASSEMBLY MARK NUMBER.
10. FABRICATOR TO SUPPLY TWO PRINTS OF ALL SHOP DETAIL DRAWINGS WITH ERECTION MARKS TO ISCOR FOR APPROVAL PRIOR TO FABRICATION.

(1) 533 × 210 × 93 UB
(2) 305 × 165 × 46 UB
(3) 600 × 250 PLATE GIRDER 250 × 50 FLANGES 500 × 10 WEB
(4) 1000 × 600 PLATE GIRDER 600 × 50 FLANGES 900 × 16 WEB
(5) 750 × 600 PLATE GIRDER 600 × 50 FLANGES 650 × 16 WEB
(6) 305 × 165 × 54 UB
(7) 900 × 350 PLATE GIRDER 350 × 50 FLANGES 800 × 12 WEB
(8) 600 × 350 PLATE GIRDER 350 × 50 FLANGES 500 × 12 WEB
(9) HOPPER PLATES 25 THICK
(10) VERTICAL SIDE PLATES FROM +913600 LVL. TO +915875 LVL. 25 THK.
(11) VERTICAL SIDE PLATES FROM +915875 LVL. TO +924150 LVL. 10 THICK 3 CR 12
(12) 305 × 305 × 283 UC
(13) 406 × 178 × 54 UB (HAUNCHES & UB)
(14) 203 × 203 × 46 UC
(15) 120 × 120 × 15 ANGLE
(16) 90 × 90 × 8 ANGLE
(17) 305 × 305 × 97 U.C.
(18) 305 × 305 × 283 UC. WITH 2/322 × 30 FLANGE PLATES

APPROVED FOR CONSTRUCTION

AS BUILT

Watson, Edwards, v.d. Spuy en v.d. Linde (Ing)

ISCOR YSKOR GROOTEGELUK

AREA 16

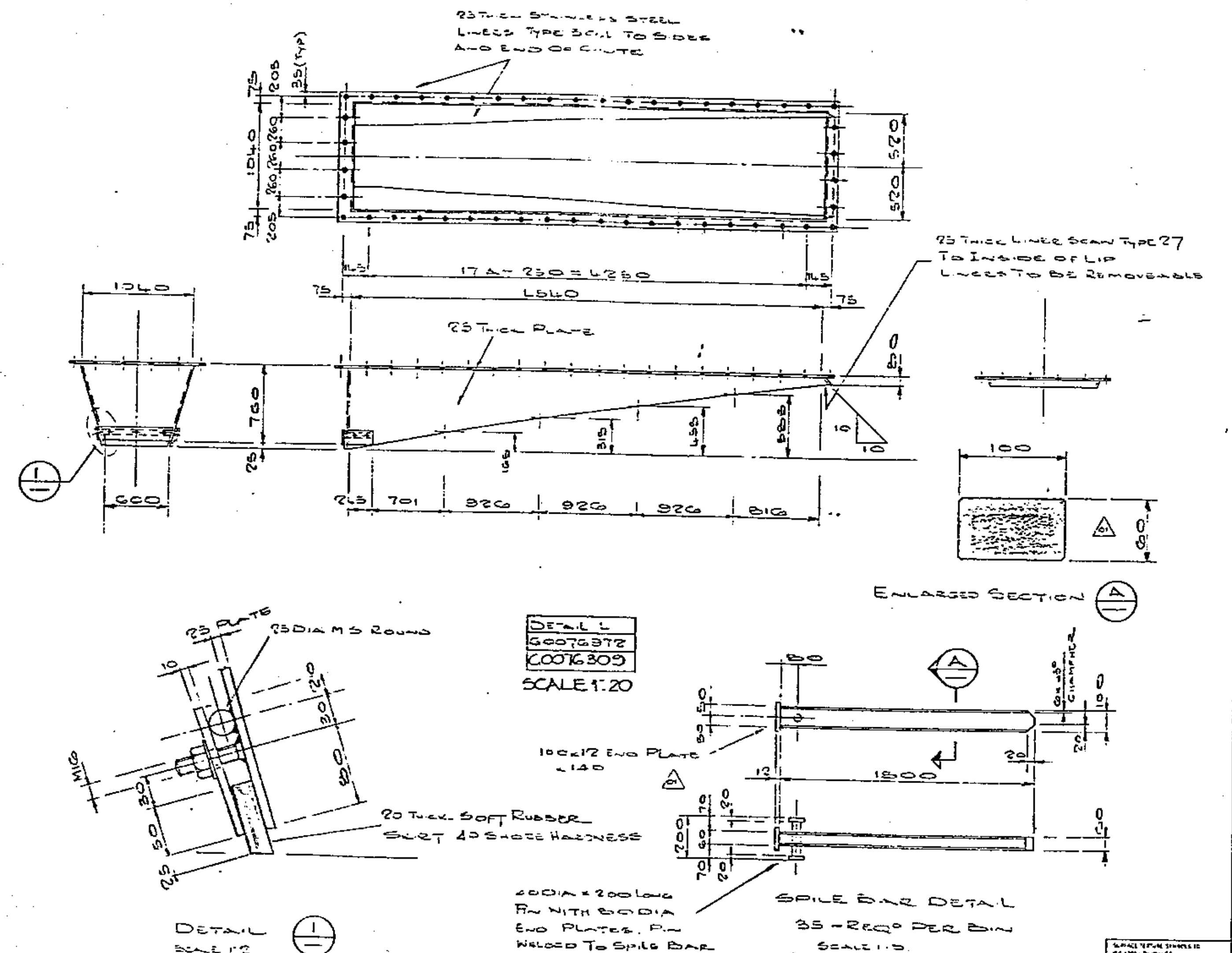
SURGE AND ASSIZING BIN

F817 G155.0

1:50

G0076309 R02 A1

DRG. No.	DESCRIPTION
G0076957	BUILDING F817G100.0 ARRANGEMENT OF ASSIZING SAMPLE BUILDING
G0076971	BELT FEEDER & BIN SUPPORT FLOOR
G0076967	BELT FEEDER
G0075404	BLOCK PLAN



PLATEWORK GENERAL NOTES

1. PLATEWORK TO BE OF WELDED CONSTRUCTION 6 mm CONTINUOUS FILLET WELD UOS
2. PLATE THICKNESS AND MATERIAL TO BE AS PROJECT SPECIFICATION
3. ALL DIMENSIONS TO INSIDE OF PLATE UOS
4. FLANGES TO BE ——— UOS
5. STIFFENERS TO BE ——— FLAT UOS
6. SUPPORT BRACKETS FROM — PLATE UOS
7. ALL HOLES TO BE 22ø FOR M20 BOLTS, ON STANDARD BM UOS
8. LENGTH OF SLOTTED HOLES DIMENSIONED ON DRAWING TO BE TOTAL LENGTH OF SLOT
9. ERECTION BOLTS, NUTS AND WASHERS TO BE PLACED IN HESSIAN BAGS AND LABELLED CLEARLY WITH THE ASSEMBLY MARK NUMBER
10. FABRICATOR TO SUPPLY TWO PRINTS OF ALL SHOP DETAIL DRAWINGS WITH ERECTION MARKS TO ISCOR FOR APPROVAL PRIOR TO FABRICATION.
11. CHUTE PLATEWORK 3CR12, SKIRT COVER FLATS AND ROUND BAR TO BE MILD STEEL

REV	BY	DESCRIPTION
A 31-7-84	A C ROW	ISSUED FOR ENQUIRY
B 2-10-84	A C ROW	LINER PLATES ADDED TO CHUTE, DIMENSIONS AND DETAIL OF SPILE BAR
0 17-12-84	A C ROW	ISSUED FOR CONSTRUCTION
01 3-2-85	A C ROW	SPILE BAR REVISED FROM FABRICATED TO SOLID
02 21/5/86	BLUE	AS BUILT

DRG No	DESCRIPTION
G0076306	GA OF 3CR12 FAB G195.0
G0076373	GA OF ...

APPROVED FOR CONSTRUCTION

AS BUILT

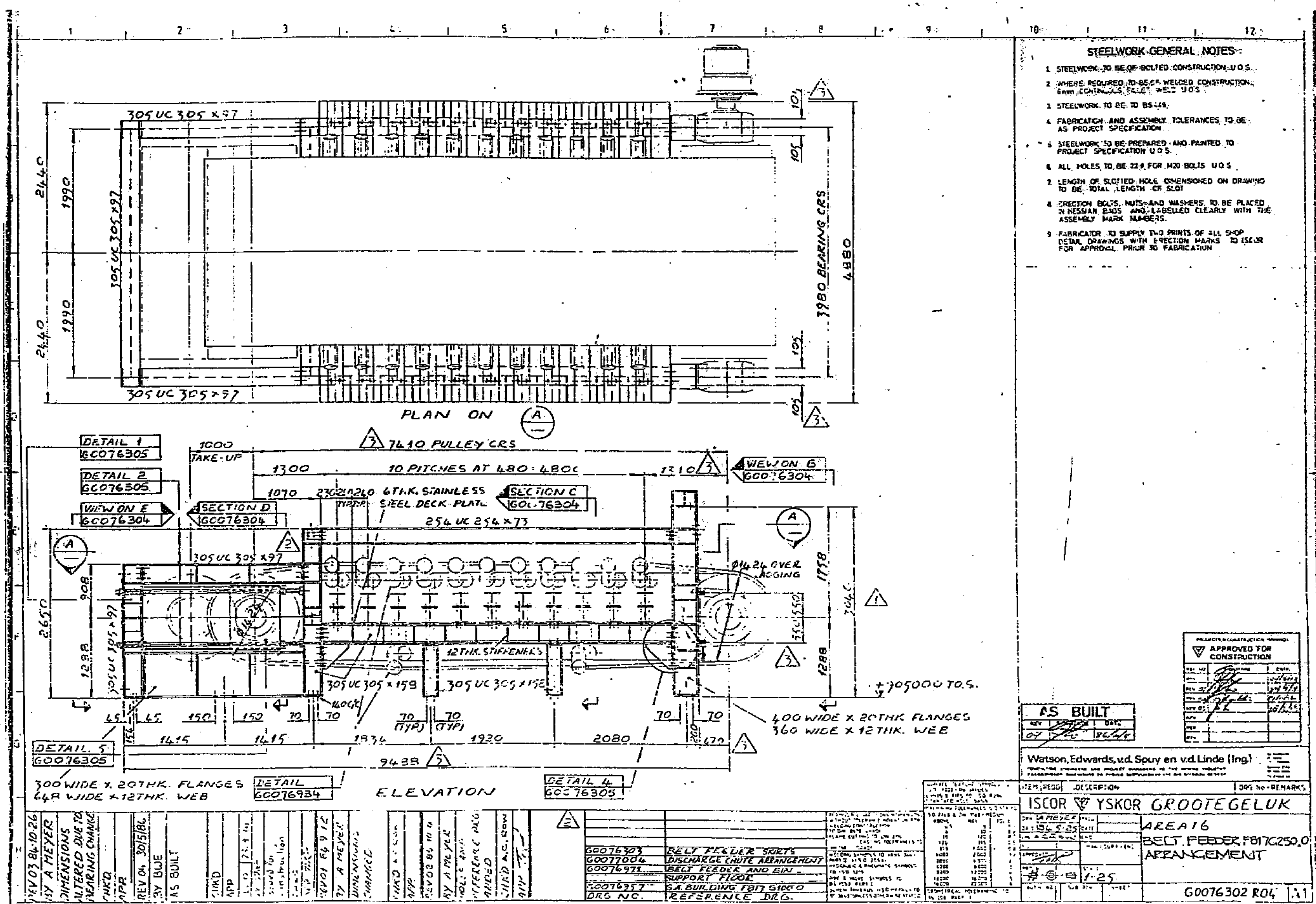
Watson, Edwards, v.d. Spuy en v.d. Linde (Ing.)

ISCOR YSKOR GROOTEGELUK

AREA 16
SURGE AND
ASSIZING BINS
FEED CHUTE

SCALE AS NOTED

G0076381 R02 A1


STEELWORK GENERAL NOTES:
1. STEELWORK TO BE OF BOLTED CONSTRUCTION U.O.S.
2. WHERE REQUIRED TO BE OF WELDED CONSTRUCTION, 6mm CONTINUOUS FILLET WELD U.O.S.
3. STEELWORK TO BE TO BS449.
4. FABRICATION AND ASSEMBLY TOLERANCES TO BE AS PROJECT SPECIFICATION.
5. STEELWORK TO BE PREPARED AND PAINTED TO PROJECT SPECIFICATION U.O.S.
6. ALL HOLES TO BE 22Ø FOR M20 BOLTS U.O.S.
7. LENGTH OF SLOTTED HOLE DIMENSIONED ON DRAWING TO BE TOTAL LENGTH OF SLOT.
8. ERECTION BOLTS, NUTS AND WASHERS TO BE PLACED IN HESSIAN BAGS AND LABELLED CLEARLY WITH THE ASSEMBLY MARK NUMBERS.
9. FABRICATOR TO SUPPLY TWO PRINTS OF ALL SHOP DETAIL DRAWINGS WITH ERECTION MARKS TO ISCOR FOR APPROVAL PRIOR TO FABRICATION.
PLAN ON A
305 UC 305 x 97
3980 BEARING CRS
4880
2440
1990
105
7410 PULLEY CRS
10 PITCHES AT 480 = 4800
1000 TAKE-UP
1300
1310
1070
6THK. STAINLESS STEEL DECK PLATE
254 UC 254 x 73
305 UC 305 x 158
12THK. STIFFENERS
Ø1424 OVER LAGGING
+705000 T.O.S.
400 WIDE x 20THK FLANGES
360 WIDE x 12THK. WEB
300 WIDE x 20THK. FLANGES
648 WIDE x 12THK. WEB
9438
1415
1834
1920
2080
2650
908
1288
1778
3066
DETAIL 1 GC076305
DETAIL 2 GC076305
VIEW ON E GC076304
SECTION D GC076304
SECTION C GC076304
VIEW ON B GC076304
DETAIL 5 GC076305
DETAIL GC076934
DETAIL 4 GC076305
ELEVATION
AS BUILT
APPROVED FOR CONSTRUCTION
Watson, Edwards, v.d. Spuy en v.d. Linde (Ing.)
ISCOR YSKOR GROOTEGELUK
AREA 16
BELT FEEDER F817C250.0 ARRANGEMENT
G0076302 R04 A1
G0076303 BELT FEEDER SKIRTS
G0077004 DISCHARGE CHUTE ARRANGEMENT
G0076971 BELT FEEDER AND BIN SUPPORT FLOOR
G0076357 S.A. BUILDING F817 G100.0
DRG NO. REFERENCE DRG.
REV 03 84-10-26 BY A MEYER DIMENSIONS ALTERED DUE TO BEARING CHANGE
REV 04 30/5/86 BY BJE AS BUILT