

# AOD Konverter – BMX studie och optimering av tippningsförloppet



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**Pro/User**  
S W E D E N  
2004

# Sandvik

Grundat År 1862

Göran Fredrik Göransson



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Sandvik MT SDK.

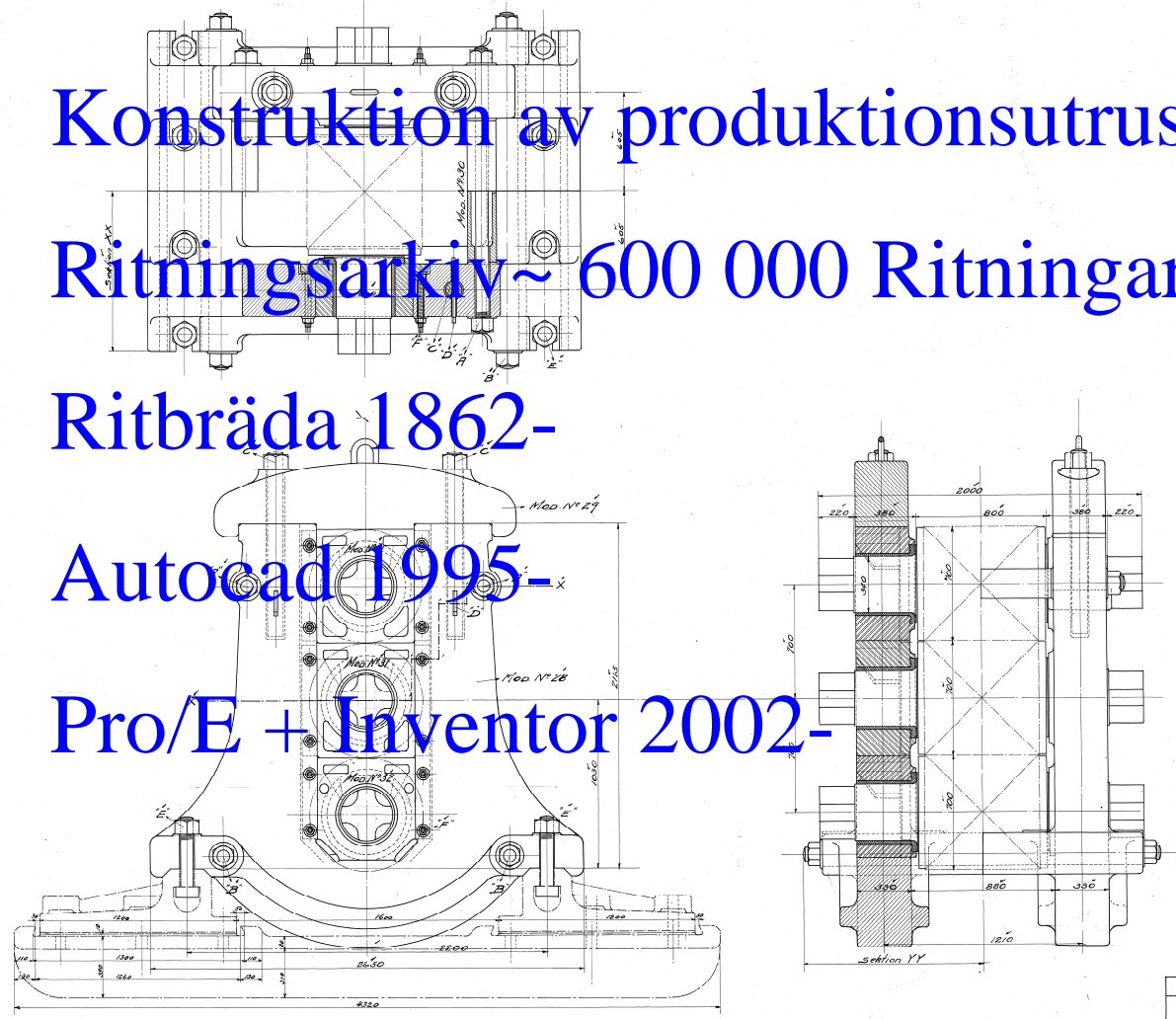
Konstruktion av produktionsutrustning

Ritningsarkiv ~ 600 000 Ritningar

Ritbräda 1862-

Autocad 1995-

Pro/E + Inventor 2002-



SANDVIKENS JERNVERKS A. B.  
GÖTVÉRKET  
KOPPELRILLSTOL  
SAMMÅTTNING  
Skala: 1:10 = 100 millimeter  
Sundsviken den 6. Aug. 1947

2 - 6
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# AOD Konverter

**Reducerar Kol**

**Chargevikt 75t**

**Slaggvikt 6t**

**Totalvikt ca:220t**



## Varför studie ?

- Omkonstruktion av konverter.
- Transmissionen dimensionerad för 900 000 Nm
- Beräkningen hos tegel-leverantören kostar 100 000Kr.
- Utvärdering av CAD-prestanda.

## Analysresultat

- Tegelleverantör: 620000 Nm 2 veckor
- Konsultföretag: > 1000 000 Nm 2 mån
- Vår analys i Pro E: 880 000 Nm 5 dagar

# Tippning av konverter



Calculating sensitivity...  
Sensitivity calculation: 100% done.  
Sensitivity calculation completed.

Study Name  
Name: SENS1

Variable Selection  
Dimension: d160.KONVERTER

Variable Range  
Minimum: 0.000000  
Maximum: 80.000000

Parameters To Plot  
XL\_1\_2.MOMENT

Steps: 30

Compute Close

XL_1_2.MOMENT
955944,1792
855944,1792
755944,1792
655944,1792
555944,1792
455944,1792
355944,1792
255944,1792
155944,1792
55944,17919
-44055,82081

Pro  
SWE  
20



# Excel Analysis

Line 7 assembly KONVERTER: Model changed since mass props calculated. May need to recalculate.  
 Redefine aborted.  
 Excel Analysis completed successfully.

**ANALYSIS**

Feature: Element Tree

Elements	Info
Analysis	Analysis
Name	MOMENT
Type	Excel Analysis
RegenRequest	Always
Definition	Changing
Result params	Defined

**Excel Analysis**

Setup

File  
 Load File... New File  
 tppres.xls

Input Settings

Dimension/Parameter	Value	Cell
TPDISTANCE	10402.2044	A1
MASS	219.309063	A2

Output Settings  
 Output cells: B1

Results

Cell name	Value
B1	865311.546227

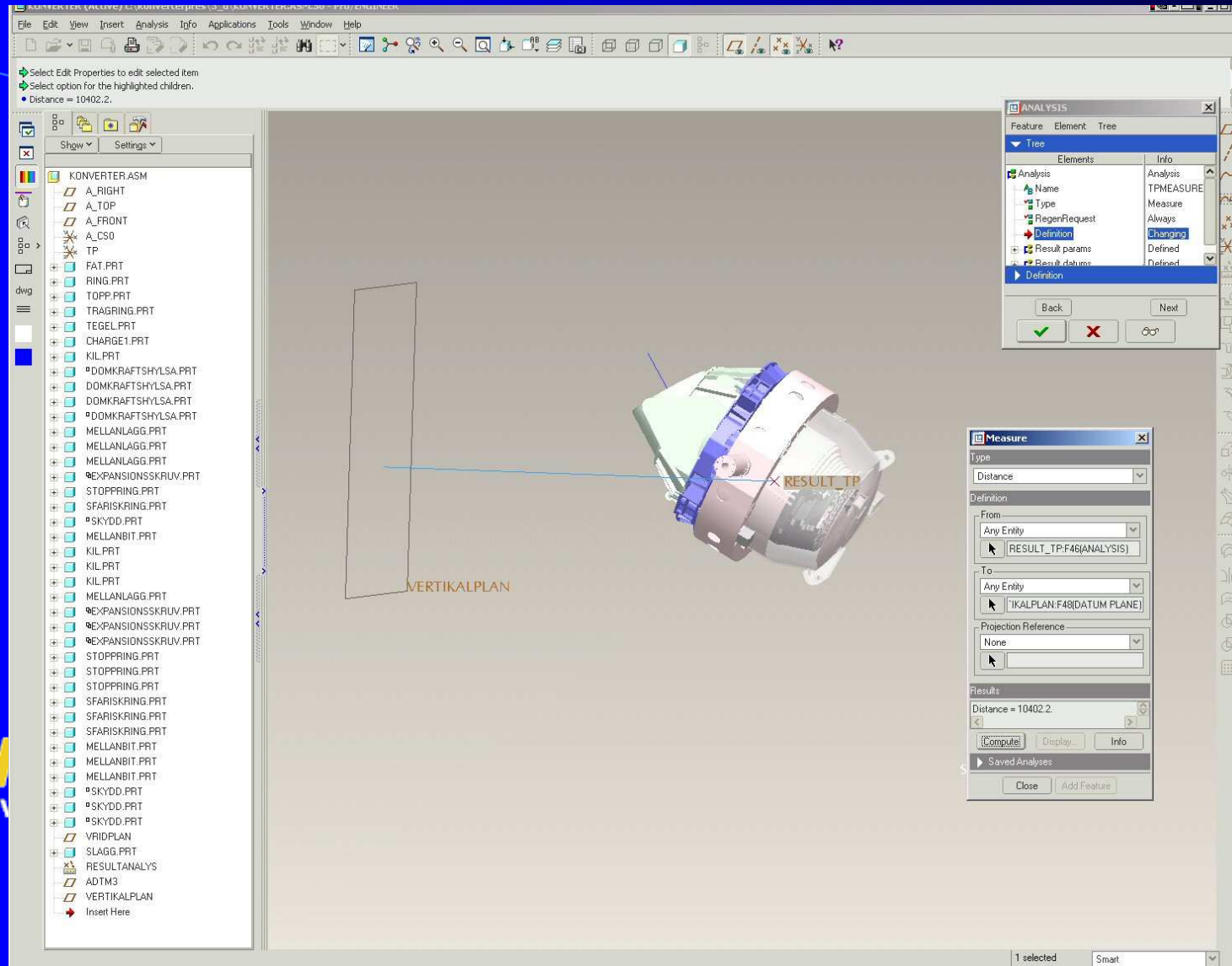
Microsoft Excel - tppres.xls

A	B	C	D	E	F	G	H
1	10402,2	865311,5					
2	219,3091						
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							

Sheet1 / Sheet2 / Sheet3



# Measure Analysis



Select Edit Properties to edit selected item  
 Select option for the highlighted children.  
 Distance = 10402.2.

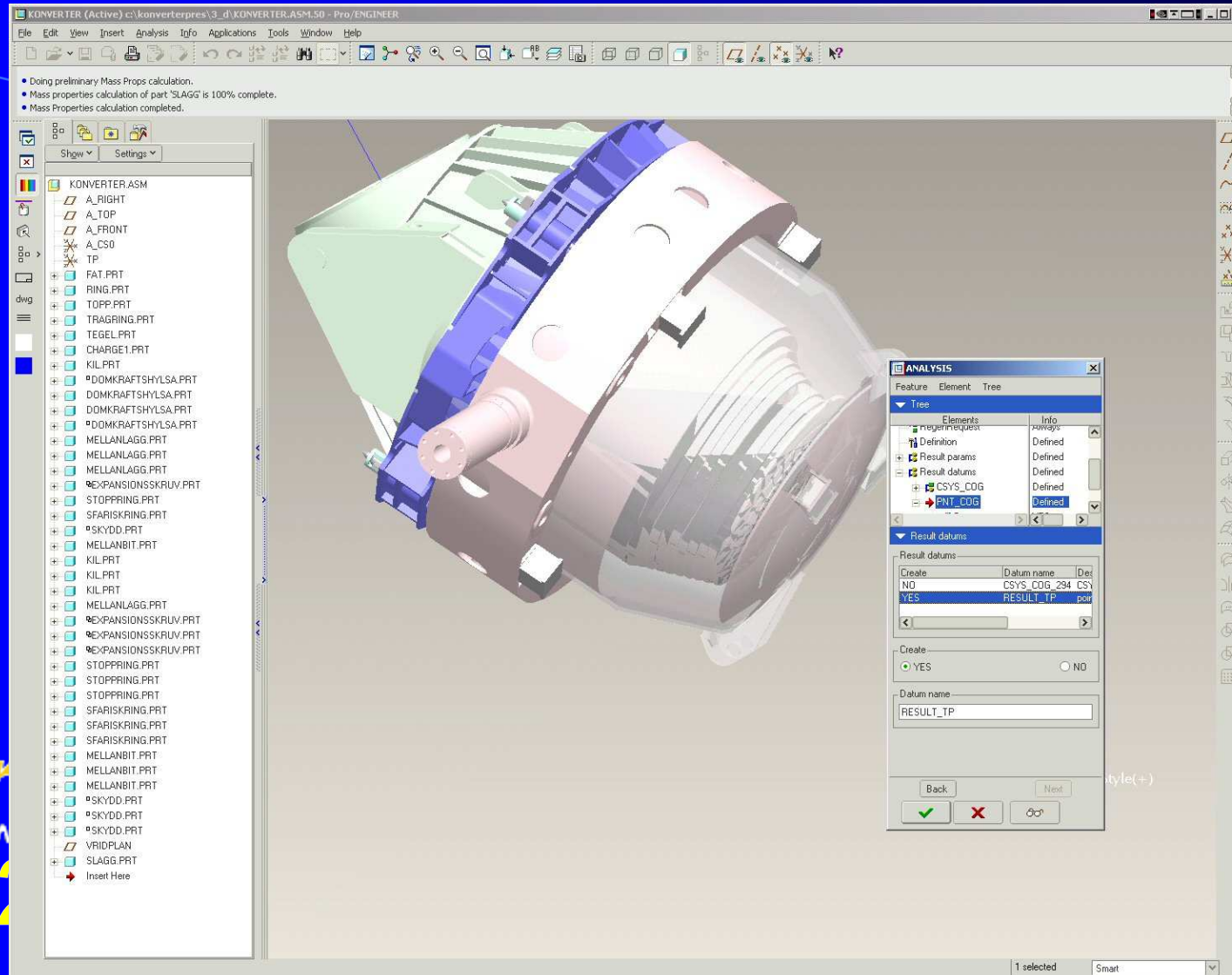
**ANALYSIS**  
 Feature Element Tree  
 Tree  
 Elements Info  
 Analysis Analysis  
 Name TPMEASURE  
 Type Measure  
 RegenRequest Always  
 Definition Changing  
 Result params Defined  
 Result delims Defined  
 Back Next  
 [OK] [Cancel] [Apply]

**Measure**  
 Type  
 Distance  
 Definition  
 From  
 Any Entity  
 RESULT\_TP:F46[ANALYSIS]  
 To  
 Any Entity  
 IKALPLAN:F48[DATUM PLANE]  
 Projection Reference  
 None  
 Results  
 Distance = 10402.2  
 Compute Display Info  
 Saved Analyses  
 Close Add Feature

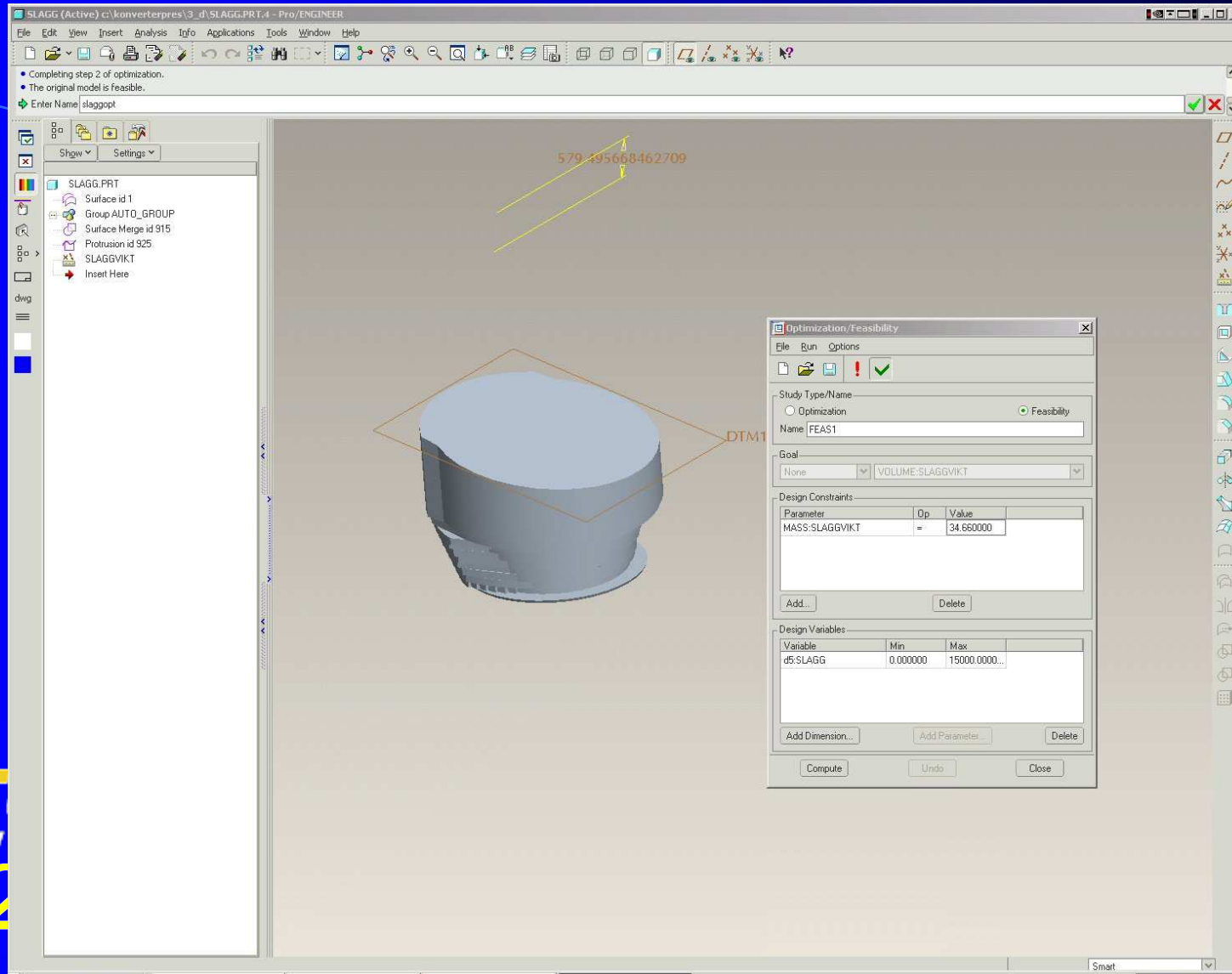
KONVERTER.ASM  
 A\_RIGHT  
 A\_TOP  
 A\_FRONT  
 A\_CS0  
 TP  
 FAT.PRT  
 RING.PRT  
 TOPP.PRT  
 TRAGRING.PRT  
 TEGEL.PRT  
 CHARGE1.PRT  
 KIL.PRT  
 \*DOMKRAFTSHYLSA.PRT  
 DOMKRAFTSHYLSA.PRT  
 \*DOMKRAFTSHYLSA.PRT  
 DOMKRAFTSHYLSA.PRT  
 \*DOMKRAFTSHYLSA.PRT  
 MELLANLAGG.PRT  
 MELLANLAGG.PRT  
 MELLANLAGG.PRT  
 MELLANLAGG.PRT  
 \*EXPANSIONSSKRUV.PRT  
 STOPPRING.PRT  
 SFARISKRING.PRT  
 \*SKYDD.PRT  
 MELLANBIT.PRT  
 KIL.PRT  
 KIL.PRT  
 KIL.PRT  
 MELLANLAGG.PRT  
 \*EXPANSIONSSKRUV.PRT  
 \*EXPANSIONSSKRUV.PRT  
 \*EXPANSIONSSKRUV.PRT  
 STOPPRING.PRT  
 STOPPRING.PRT  
 STOPPRING.PRT  
 SFARISKRING.PRT  
 SFARISKRING.PRT  
 SFARISKRING.PRT  
 MELLANBIT.PRT  
 MELLANBIT.PRT  
 MELLANBIT.PRT  
 \*SKYDD.PRT  
 \*SKYDD.PRT  
 \*SKYDD.PRT  
 \*SKYDD.PRT  
 VRIDPLAN  
 SLAGG.PRT  
 RESULTANALYS  
 ADTM3  
 VERTIKALPLAN  
 Insert Here

1 selected Smart

# Model analysis



# Optimization feature



SLAGG (Active) c:\konverterpres\3\_d\SLAGG.PRT.4 - Pro/ENGINEER

File Edit View Insert Analysis Info Applications Tools Window Help

• Completing step 2 of optimization.  
• The original model is feasible.  
Enter Name: slaggopt

579.495688462709

DTM1

Optimization/Feasibility

File Run Options

Study Type/Name  
 Optimization  
 Feasibility

Name: FEAS1

Goal  
 None | VOLUME:SLAGGVIKT

Design Constraints

Parameter	Op	Value
MASS:SLAGGVIKT	=	34.660000

Add... Delete

Design Variables

Variable	Min	Max
d5:SLAGG	0.000000	15000.000000

Add Dimension... Add Parameter... Delete

Compute Undo Close

Pro  
S W  
2

# Massa-analys



SLAGG (Active) C:\konverterpres\3\_d\SLAGG.PRT.1 - Pro/ENGINEER

File Edit View Insert Analysis Info Applications Tools Window Help

- Doing preliminary Mass Props calculation.
- Mass properties calculation of part 'SLAGG' is 100% complete.
- Mass Properties calculation completed.

Shgw Settings

SLAGG.PRT

- Surface id 1
- Surface id 860
- Surface Merge id 915
- Prolusion id 925
- Insert Here

**Model Analysis**

Type  
Model Mass Properties

Definition

Accuracy  
 Use default accuracy  
Rel accuracy 0.000010

Coordinate System  
 Use default

Results

VOLUME = 1.5702061e+10 MM<sup>3</sup>  
SURFACE AREA = 3.8451070e+07 MM<sup>2</sup>  
DENSITY = 3.0000000e+09 TONNE / MM<sup>3</sup>  
MASS = 4.7106183e+01 TONNE

CENTER OF GRAVITY with respect to \_SLAGG  
X Y Z 1.4872459e+02 1.9570284e+03 0.

[Compute] [Info]

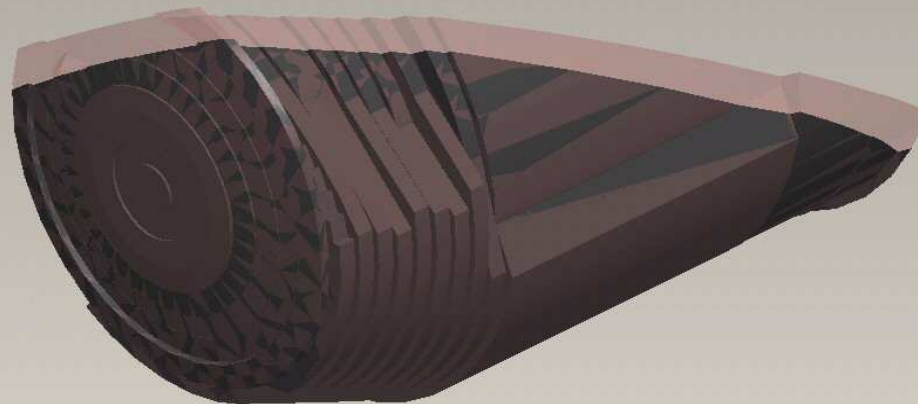
Saved Analyses  
[Close] [Add Feature]

1 selected Smart

## Analyser i trädets (BMX)

- Massa-analys för smälta och slagg.
- Optimering av mått, konstant massa.
- Tp för Konverter. Datum feature => TP-point
- Mätning av TP <-> tippaxel. (Hävvarm)
- Excel “analysis”, samband för vridmoment.

# 75 t smälta och 6t slagg



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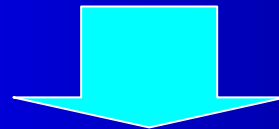
INSERT MODE



# Geometrisk Modell

- Modellera tegel (ca 70 t, muras om /14 dag.)
- Smälta och Slagg i var sin part
  - Densitet stålsmäta ca  $7.8\text{t/m}^3$ , slagg  $3\text{t/m}^3$ .
  - Parterna “byggs” av tegelyta, copy surface.
  - Horisontell yta, mått variabel för optimering.
  - Ytorna=>Merge => Solidify.
  - Vikt konstant 75t smälta respektive 6 t slagg.

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-Optimation feature.

## Studien i 3 delar

Modellera Geometri

BMX Analyser, optimering

Tippnig

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