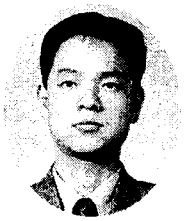
♣ 소프트웨어 소개 ♣

SCIA(시아)사 소개

(SCIentific Application grop)

- ESA-Prima Win Structural Analysis)
- HyperSteel (CAD)
- CIM-Plate (CIM)



김 택 완*

1. Instruction

SCIA-SCIentific Application group-started early 1974 and merged in 1993 with W+B Software -a former Witteveen + Bos Engineering Consultants daughter company- forming the SCIA Group with headquarters in Belgium. In 1996 the shareholders group was extended with Campus Technology Investment Cie, a funding company from L.M.S. (Leuven Measurement Systems) International and GIMV (Investment Company of the regio Flanders). SCIA Group is owned by the holding company SCIA International nv, belonging to Campus Technology Investment Cie and to Software Adventure cv (management & employees & earlier shareholders).

The SCIA Group has offices in Belgium (Herk-de-Stad), the Netherlands (Oosterbeek), Germany (Iserlohn), France (Villeneuve d'Ascq), Czech Republic (Brno) and Korea (Seoul) and is represented by partner companies in various countries, among which Austria-Czechia-Slowakia (MB-Integra Wien, Marocco (B.E.B.F.), Algeria (S.A.S.A.), Poland (Evatronix) and China (TechSino Technology).

It is remarkable that SCIA can compete on different fronts: CAE, CAD steel, CAD concrete, Fabrication software and also in various regions in the world. A unique concept of FULL Integration(CAE-CAD-CIM) is found by SCIA, without having to pass through standard or non-standard exchange files and so on like competitors do. The SCIA expertise is broad in structural I.T. (Information Technology); design aspects are considered with due respect to fabrication technology. It is generally considered that building process optimisation comes through a global improvement of all processes, not by improving just one aspect.

2. Expertise and Products

SCIA is an engineering company with extensive know-how and expertise in the building industry

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(civil & structural engineering) and in software writing. The combination of software technology and engineering has resulted in successful products: **ESA** suite of structural analysis programs, **Slab-Concrete** structural analysis for prefab concrete slabs, **HyperSteel** for AutoCAD r14 and **Steelfab** CAD applications for steel design and fabrication drawings, **CIM-Steel** steel structure manufacturing software, **CIM-Plan** steel structure manufacturing planning software, **CIM-Beam** and **CIM-Plate** steel manufacturing NC-software, **AutoStruct** CAD Reinforced Concrete Structures, **AutoCAD Floor & Preslab** (prefab concrete slabs integrated automation) ...

Innovation is achieved by incorporating modern database techniques, advanced analysis algorithms, practical engineering know-how and a user-friendly modern interface. SCIA has a major research project on multimedia engineering software and telematics.

The SCIA Group and its partners are professionals with high quality standards in product supply, training & education and in servicing software.

3. ESA-Prima Win

ESA-Prima Win (Engineering Structural Analysis on Windows) is a fully integrated application for the analysis and design of general three-dimensional building structures in steel, concrete and other materials (see Fig. 1). The software package integrates engineering know-how and analysis functionality in one environment and adds new software features.

The main concern during the development of this software is reducing the required time for calculations, while improving the comfort and ease-of-use for the user and the quality of the output. Developed as a 32 bit application for Windows (NT, 95, 98), the program uses the advantages of this operating system to a full extent.

A part of this environment is dedicated to steel detailing. The main components for the steel design and detailing are:

- the structural analysis : 2D and 3D frame analysis, inclusive second order analysis and non-linear phenomena's
- the member design : appropriate checks from several codes are implemented (EC3, DIN18800, ONORM B 4300, NEN6770/6771, SIA161, CM66, BS5950, AISC LRFD, AISC ASD, GBJ 17-88, Korean code, CSN 73 1401, STN 73 1401)
- the connection design (see chapter 3.1)
- the integration with CAD modeling applications using the ISO-STEP technique.

3.1 Expertise in Connection Design

The ESA-Prima Win Connect modules cover the design of rigid and pinned frame connections and also welded truss connections. The technology and calculation methods are based on EC3[1], together with additional material obtained from research studies[2), 3), 4), 5)] and designers practice.

For the input and check of the connection data, several approaches are considered and implemented. The first approach is the traditional manual input: the user introduces the different parts of the connection and the program checks the composed joint according to the proper rules.

The program informs the user about the critical failure modes. The user can adapt the design according to this information. See chapter 3.2.

The second approach is that the program proposes a possible solution, based on previous calculations and on standard solutions, which

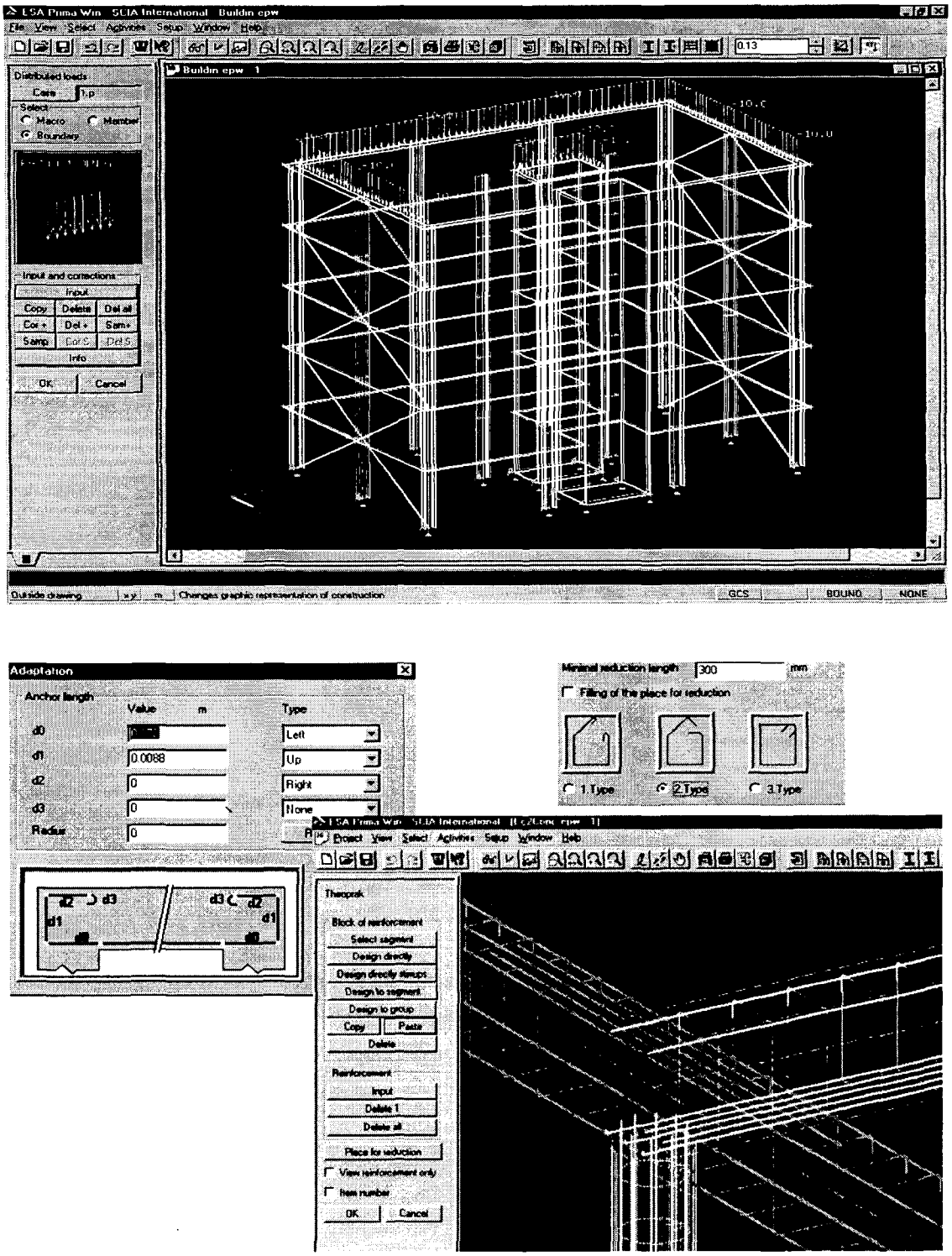

Fig. 1 The ESA-Prima Win environment and practical design of RC

are stored in a database. The quality of the proposed solution depends on the quality of the database contents, the so-called template library.

The third approach is a wizard: that will take the hand of the user step by step through his design process. Each step will contain limited information to be introduced and will give a summary and the status of the results. See chapter 3.2.

3.2 Frame Connections

The design of the connection is done in the graphical environment of ESA-Prima Win. The nodes to check are selected graphically with the mouse pointer. The elements of the connection (haunches, stiffeners, angles, bolts...) are entered in dialogue windows. Bolts and anchors are selected from a bolt library, open to the designer. All elements are visible on the screen, as shown in Fig. 2.

All relevant factors and coefficients for the design checks are proposed by the program and editable by the user (basic data of Eurocode 3, limits for bolt positions, limits for intermediary distances of bolts, minimum weld sizes, slip factor and moment factor of preloaded bolts…).

The ultimate limit state of the connection is compared with the actual internal forces in the connection. The critical load case/combination and the limiting parts are displayed (Fig. 3).

For rigid connections the rotational stiffness is analysed. The stiffness diagram (Fig. 4) classifies the connection (hinged, rigid, semi-rigid). The actual rotational stiffness of the connection is compared with the applied rotational stiffness in the analysis model. On users request, the actual rotational stiffness is transferred to the analysis model.

A detailed calculation note is sent to the printer or to the document. Parts of the output are illustrated in Fig. 5. Detailed drawings with dimensioning of all parts of the connection are generated automatically (Fig. 6).

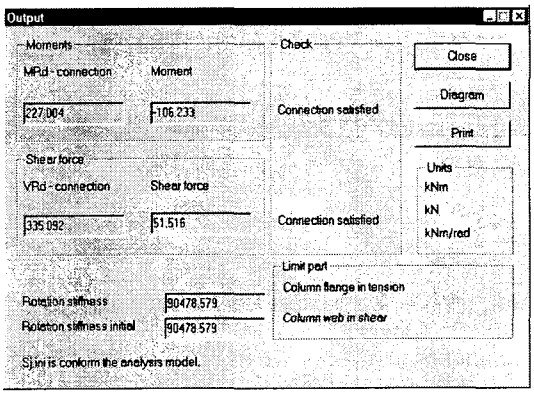

Fig. 3 Results for bolted frame connection

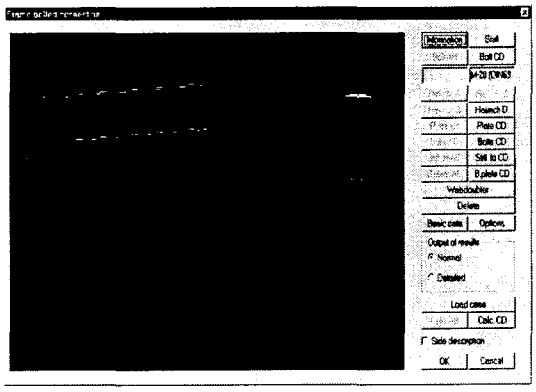

Fig. 2 Manual input for frame connection

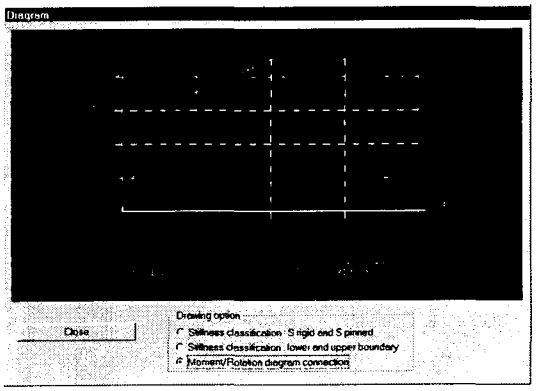

Fig. 4 Moment-rotation diagram

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2. Design moment resistance MRd

2.1. Design resistance of basic components

For individual bolt row:

Bt,Rd=176.40kN

row	Ft,fc,Rd	Ft,ep,Rd
1	309.65	352.80
2	299.45	352.80
3	299.45	352.80
4	299.45	352.80

data		
Vwp,Rd	416.84	kN
Fc,wc,Rd	444.04	kN
Fc,fb,Rd	628.56	kN

2.2. Determination of Mj,Rd

row	h[mm]	Ft[kN]
1	609.90	309.65
2	355.90	107.19
3	261.90	0.00
4	46.90	0.00

Mj,Rd=227.00kNm

Mj,Rd=227.00kNm (inclusive normal force)

2.3 Determination of Mj,Rd for compressed haunch at beam

data		
Mj,Rd	193.04	kNm
MSd	-45.30	kNm

3. Design shear resistance VRd

VRd =335.22kN

4. Stiffness calculation

4.1. Design rotational stiffness

Sj data		
Sj	90478.58	kNm/rad
Sj,ini	90478.58	kNm/rad
z	523.50	mm
mu	1.00	
k1	2.73	mm
k2	10.70	mm
keq	5.69	mm

4.2. Stiffness classification

Stiffness data		
E	210000.00	MPa
Ib	162700001.97	mm^4
Lb	3758.32	mm
frame type	braced	
S1	72728.16	kNm/rad
S2	4545.51	kNm/rad

System RIGID

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Fig. 5 Output for frame connection

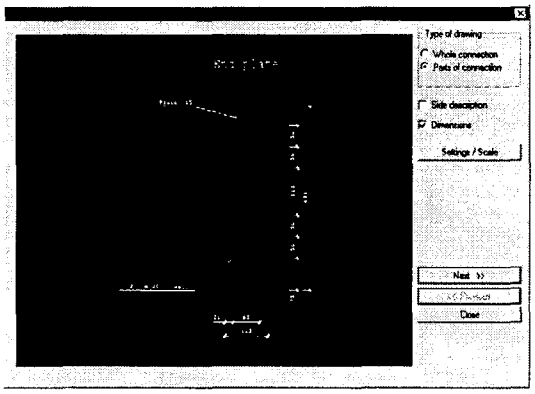

Fig. 6 Detailed drawing

4. HyperSteel (CAD Steel Products) (The new CAD for steel development, a cooperation with DSC)

- 3D modelling of steel structures in AutoCAD R14
- Uses the latest ARX technology and adds to AutoCAD the objects grids, profiles, plates, bolts, welds, operations on profiles and plates, connections, structural elements and generated drawings
- The AutoCAD interface is extended for manipulating the new objects

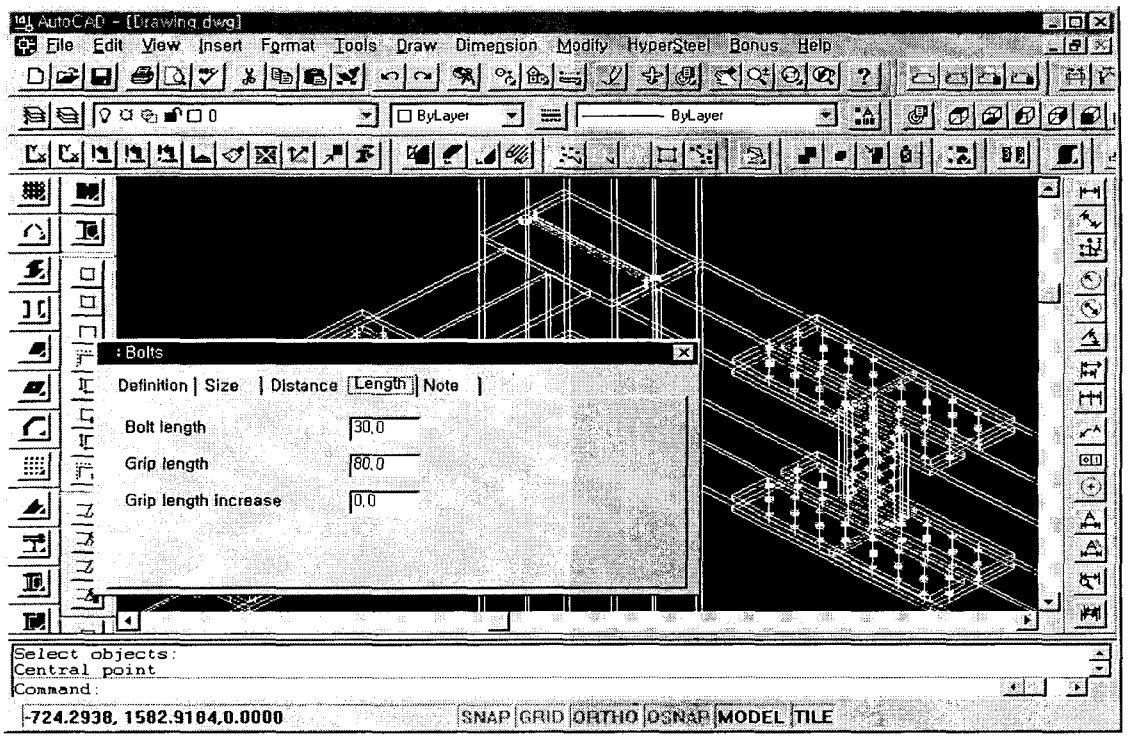

Fig. 7 HyperSteel

- The use of ARX(MFC) dialogue boxes gives a direct coupling between the changes and the model (Fig. 7)
- Visual Lisp(AutoLisp) for AutoCAD R14 is opened for handling the object of HyperSteel
- The model can be visualised with standard AutoCAD commands HIDE, SHADE, RENDER (Fig. 8)
- Blocks can be inserted into the model as special elements and come into the list of materials and the generated drawings
- It is a PC product for Windows NT 4.0
- Short learning time (2 days for a technician knowing AutoCAD)
- The DWG is used as the logical database, very efficient and condensed storage of models
- Rules language for user developments (connections, details) in access
- Editing facilities with AutoCAD properties of all new objects, the rule-based objects are automatically updated if one of the components is modified
- Automatic generation of all drawings (overview, groundplan, box-view, assembly and mono drawings) (Fig. 9)
- Management of generated drawings. If the model changes, the affected drawings are

Fig. 8 Rendering in HyperSteel

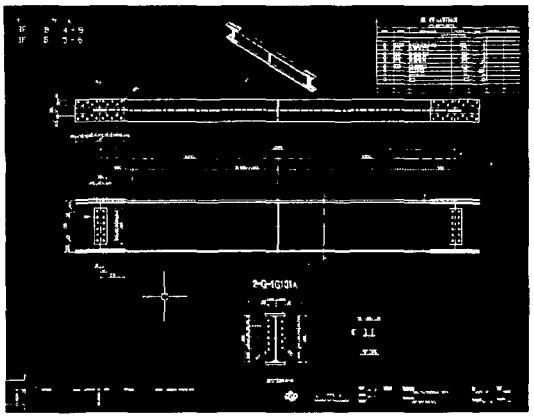

Fig. 9 Mono drawing

indicated and can be actualised automatically

· Automatic generation of bill of material (assemblies, profiles, plates, bolts, ...)

· Automatic generation of NC machine code at a high fabrication level (positioning of parts on machines, 1D & 2D cutting optimisation)

· Uses the geometry and profile data of ESA-Prima Win for auto-drawing

5. CIM-Steel & CIM-Plate & CIM-Plan (Computer Integrated Manufacturing for STEEL structures and Numerical Control and planning of the production in the workshop)

· Advanced fabrication software with the major aspect INTEGRATION

- between CAD model and production operations
- between various machines of different manufacturers
- between design office and shop floor (automatic feedback) including distance operations (through modem)

· Database material management with bill of material, operation lists, building phase lists, transportation and shipment lists, purchase of raw material, stock management, delivery control, ...

· 1D and 2D optimisation routines for minimal

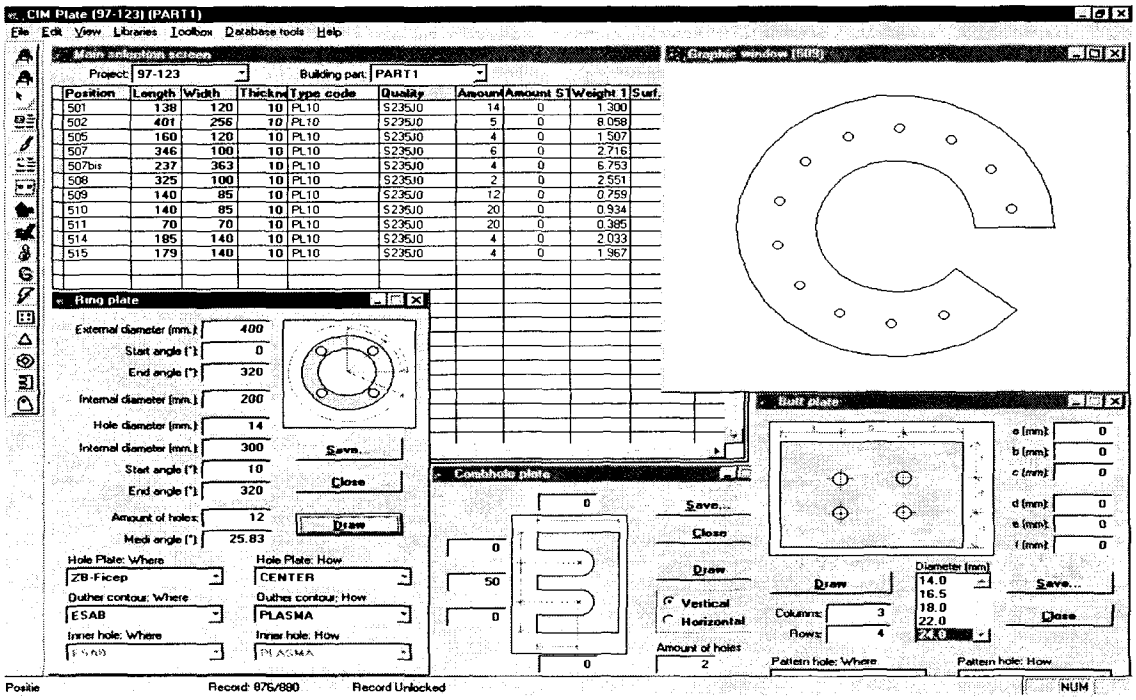

Fig. 10 CIM-Plate macros

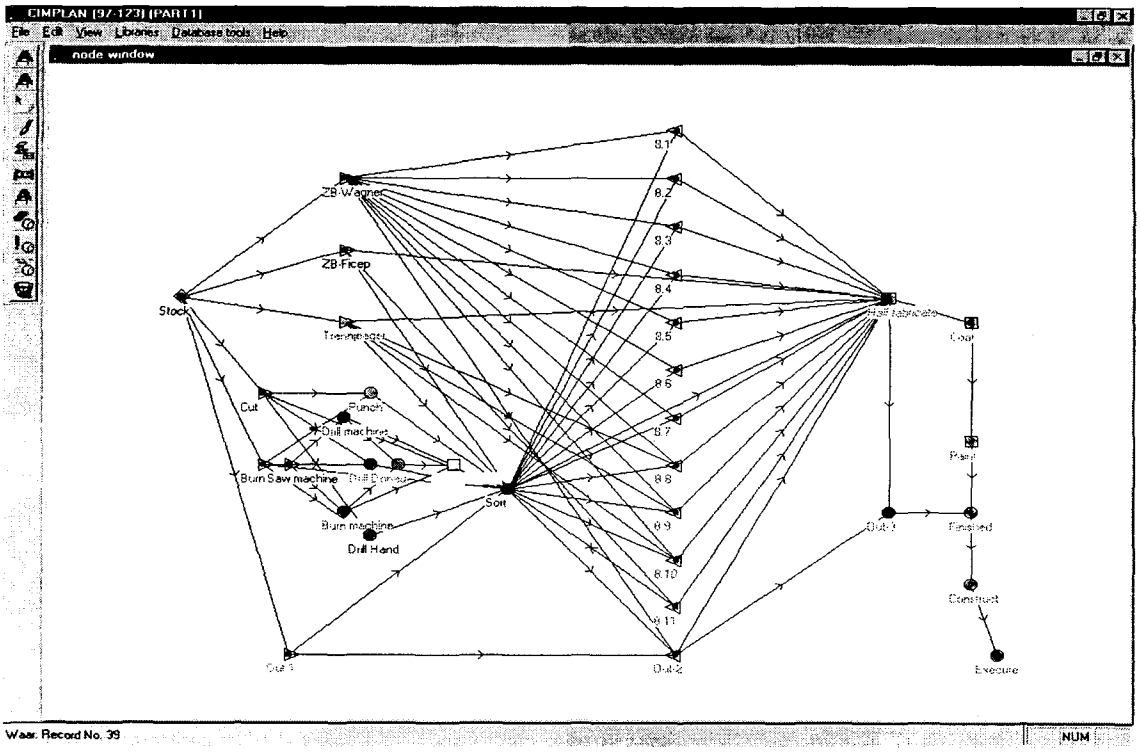

Fig. 11 CIM-Plan

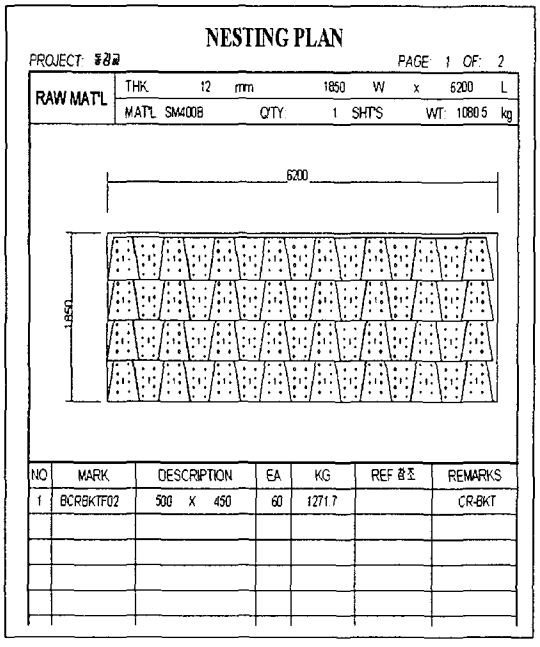

Fig. 12 Nesting plan report

loss of steel material during cutting of sections and plate sheets: true nesting software with advanced functionality.(Fig. 10)

- Modern user interface (CIM-Plate and CIM-Plan are native Windows products, CIM-Steel is being rewritten in Windows environment) with link to MS- EXCEL and other spread-sheets (Fig. 11)
- Broad range of products: from BOM over production control, time management, NC postprocessing, ...
- Extensive practical experience (over 200 machines installed)
- Customer specific developments (e.g. production planning, cost calculation, ...)
- Nesting Plan, Piece Drawing, and Bill of Material report (Fig. 12).

6. System Requirement

· ESA-Prima Win 3.10, CIM-Plate :
  - Pentium 100Mhz
  - Windows 98/NT4.0
  - RAM 32MB
· HyperSteel 4.1 :
  - Pentium 166Mhz
  - Windows NT4.0
  - AutoCAD R14
  - RAM 64MB

References

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