VAAL UNIVERSITY OF TECHNOLOGY

CIVIL ENGINEERING

WORK INTEGRATED LEARNING (WIL)

Guidelines

(2005 Edition)

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1. PROGRAMME CONTENTS

1.1 General Aspects

The employer should take cognisance of the following factors in planning a detailed Work Integrated Learning programme for the Vaal University of Technology students:

The ideal is to give the student practical training in as many aspects relating to Civil Engineering as possible. This would imply exposure to most (if not all) of the categories listed in 1.3. The **minimum requirement** is that a student must acquire an acceptable level of proficiency in at least four (4) of the seven (7) major categories. Companies can, through mutual co-operations/partnerships/liaisons/alliances with other companies, consider or encourage students to go, for an interim period, to another company to get exposure in those categories which are not part of the mother company's core business, e.g. in Construction Supervision and Materials Testing.

The programme should be such that the intellectual demands on the student are increased as he/she progresses through the programme. Degrees of difficulty and responsibility should be increased as the student achieves a greater skills proficiency. **The emphasis should be on project work, especially in the second semester of Work Integrated Learning.** It is therefore envisaged that the student will be required to participate in some projects. These projects should cover technical investigations or studies as required by the employer. At the end of the second semester of Work Integrated Learning, the student must submit **one (1)** of these projects' report to the Vaal University of Technology; the format of reporting should be based on the guidelines obtained from the Work Integrated Learning Office.

Projects could include studies/tasks/reports by the student on related training aspects as required by the employer, and should comply with the following requirements:

It should address some engineering aspects of the student's Work Integrated Learning.
The reports should address the engineering theory of that aspect which the student is addressing.
The reports must also reflect the student's critical assessment of the practical and theoretical aspects of the topic he/she is addressing.
The reports must present evidence of wider reading and references must be acknowledged in the correct way.

Typical examples of suitable projects are:

Production analysis/comparisons for civil engineering plant applications.
Investigating the use of alternative or new materials.
Compiling guidelines, procedures.
Investigating the application of appropriate technologies.
Time studies.
Literature surveys.

1.2 Critical Thinking

In trying to achieve the Work Integrated Learning goals, students should acquire and exercise critical thinking skills. Critical thinking may include the following features:

Critical thinkers decide on what they think and why they think it.
Critical thinkers seek other views and evidence beyond their own knowledge.

Critical thinkers decide which view is the most reasonable, based on all the evidence.

Critical thinkers make sure that they use reliable facts and sources of information; when they state a fact that is not common knowledge, they will briefly say where they have obtained the information.

When critical thinkers state an opinion, they anticipate questions others might ask and thus have thoughtful answers ready to support their opinion.

Three aspects of critical thinking are: argument skills, cognitive processes, and intellectual development.

Argument skills - Students exercise the skills of analysing and constructing arguments based on logic. This emphasis on analytical skills may improve the students' ability to justify beliefs they already hold.

Cognitive processes - Here students interpret problems or phenomena based on what they already know or believe. They construct a mental model of the problem or situation around a claim or hypothesis which is supported by reasoning and evidence. Three kinds of knowledge contribute to the model: 1) the facts involved in the particular discipline, 2) knowing the procedures on how to reason in the discipline and 3) evaluating the goals, the context, the cause-and-effect relationships, and the progress of inquiry or problem solving. However, new learning is not stored as a collection of isolated facts, but as meaning constructed into patterns or scripts as understood by the student.

Intellectual development - this approach examines students' relationship to belief and knowledge.

1.3 SYLLABUS GUIDE CATEGORIES

MINIMUM REQUIREMENTS

To fulfil the requirements of the National Diploma, a student must complete at least one year (52 weeks, which could include up to three (3) weeks of annual leave) of applicable Work Integrated Learning under the supervision of a qualified mentor/supervisor, preferably during the second year, i.e. after completing the academic components S1 and S2 at the Vaal University of Technology.

No student will be allowed to enrol for academic subjects at the Vaal University of Technology while undergoing Work Integrated Learning, unless the Work Integrated Learning period is extended. Requests of this nature will only be considered with the written approval of the employer concerned.

NB: No holiday-work, i.e. work done during the Vaal University of Technology holidays while the student is registered for any of the academic semesters of the theoretical component at the Vaal University of Technology, will be recognised as Work Integrated Learning. In essence this means that Work Integrated Learning will only be valid if done while the student is not registered for any of the academic semesters.

The ideal is to give the student practical training in as many aspects related to Civil Engineering as possible. This would imply exposure to most of the topics listed below. The **minimum requirement** is that a student must acquire an acceptable level of proficiency in at least four (4) of the following major seven (7) categories:

1.3.1 ADMINISTRATION

Safety (OHS Act)
Organisational structure within business
Financial planning, cash flow forecasting
Contract documents
Office and site administration: Meetings, reports, minutes, memo's; site diary; order, deliver and control of materials, labour related issues such as time sheets
Productivity and work study; quality control
Elementary management and accompanying decisions
Environmental awareness

1.3.2 DRAWING

1.3.2.1 SABS 0400
CAD training
Drawing office practice, i.e. documentary systems, indexing and micro-film production

1.3.2.2 Scales of drawings
Printing and line work
Dimensioning
Site sketches of site conditions

1.3.2.3 Preparing working drawings (either on a drawing board or using a CAD-system) for earthworks, roads, railway lines, underground pipe lines, concrete structures, structural steel structures and architectural buildings

1.3.2.4 Experience in reading complex drawings such as for freeways, bridges, multi-storey buildings, shopping centres, etc

1.3.2.5 Water
Gauging weirs
Water towers, reservoirs, earth dams, concrete dams
Drawing of flow diagrams, hydrographs and hyetographs, detailing of anchor blocks, couplings and connectors, etc

1.3.3 SURVEYING

1.3.3.1 Base line measurement
Setting out of elementary structures
Linear surveying
Levelling for earthworks design
Contouring
Setting out of levels; sight rails
Levelling of cross sections and grade lines
Draw longitudinal and cross sections
Precise levelling
Reduction of all fieldwork (rise & fall and collimation methods)
Inverted staff levelling
Volume calculation

1.3.3.2 Traversing
Tape and E.D.M. traversing
Reduction of all fieldwork

Setting out: by co-ordinates
deflection angles and distances

1.3.3.3 Tacheometry
Observing stations and plot on plans

1.3.3.4 Curves
Staking of a horizontal circular curve, etc
Setting out of PI, CP, etc

1.3.4 DESIGN
Get exposure to/work in a team involved with and get experience/learning in:

1.3.4.1 Roads: (Gravel, flexible & rigid pavements)
Do a design project including:
Horizontal and vertical curves
Earthworks (mass-haul diagrams, cut and fill)
Drainage design
Longitudinal sections
Cross-sections

1.3.4.2 Steel structures
Design of roof trusses
Design of beams, purlins and girts
Design of crane girders (compound and plate)
Design of columns and bases
Design of connections e.g. moment end plate (bolted and welded)

1.3.4.3 Concrete structures
Foundations
Columns
Beams
Slabs
Retaining walls
Bending schedules

1.3.4.4 Timber
Shuttering
Roof trusses
Beams
Columns
Connections (nailed and bolted)

1.3.4.5 Masonry
Unreinforced load-bearing walls
Unreinforced columns

1.3.4.6 Water
Determination of hydraulic and energy grade lines, thrusts/forces, flow, velocity, and head loss
Design for sizing of various water and wastewater treatment units, and hydraulic profiles through process units
Hydrograph analysis and determination of unit hydrographs
Analysis of rainfall data for frequency prediction
Drainage assessment and use of rational and other methods to obtain flow for design of storm sewers

Design for flood routing and flood lines
Statistical analysis of data
Design of anchor blocks, pipe bedding, water supply pipe line systems, water storage facilities, pumping, stormwater systems, domestic wastewater systems, surge tanks and protection against water hammer and pipe corrosion
Selection of materials for conduits, flow measuring devices, etc
Sewage treatment
Gauging weirs

1.3.4.7 Sport & Recreation facilities

1.3.4.8 Where applicable, the application of SABS 0400

1.3.5 CONTRACTS

Pre-tender, tender, pre-contract, contract planning phases
Contract planning techniques such as bar charts, precedence diagram method, critical path scheduling, linear scheduling
Hand over, retention period, commissioning period
Resource scheduling (labour, plant, material)
General conditions of contracts
Bill of quantities
Estimating and build-up rates
Measurement
Price adjustment schedule and payment certificates
Planning, organising, activate, control systems/methods
Quality and time management
ISO 9000 series
Safety (OHS Act)

1.3.6 CONSTRUCTION SUPERVISION

Get hands-on and monitoring experience/learning in:

Ability to read drawings, set-out, construct and finish
Site establishment
Safety concerning trench excavation, large earthwork operations, inspection of sewer lines, OHS Act
Concreting - mix design, transporting, placing, compaction and testing
Materials - introduction to sand, stone, timber, reinforcing, cement, lime, aluminium, plastics, structural steel, pipes
Quarrying and crushing
Environmental awareness
Introduction to codes and regulations: TRH, SABS, etc.
Earthworks - site clearance, excavations and stabilisation, backfilling, borrow pits
Foundations, piling
Structures - columns, beams, floors, roofs and methods of construction
Construction plant
Repair work to structures
Removal and moving of existing services
Roads - stabilisation, modification of material and testing. Construction of sub-grade, sub-base, base, wearing course, kerbing and channelling
Rail applications
Pipelines - supplying, laying and bedding of all types of pipes, conduits, couplings and testing

Fixing of reinforcing steel, different methods of tying reinforcing, use of cover blocks and spacers
Erection and stripping of formwork and scaffolding, the different types, storage, protection
Application of geo-synthetic materials including laying and finishing of
Quality assurance and control (ISO 9000 series)
Construction plant and maintenance

1.3.7 MATERIALS TESTING

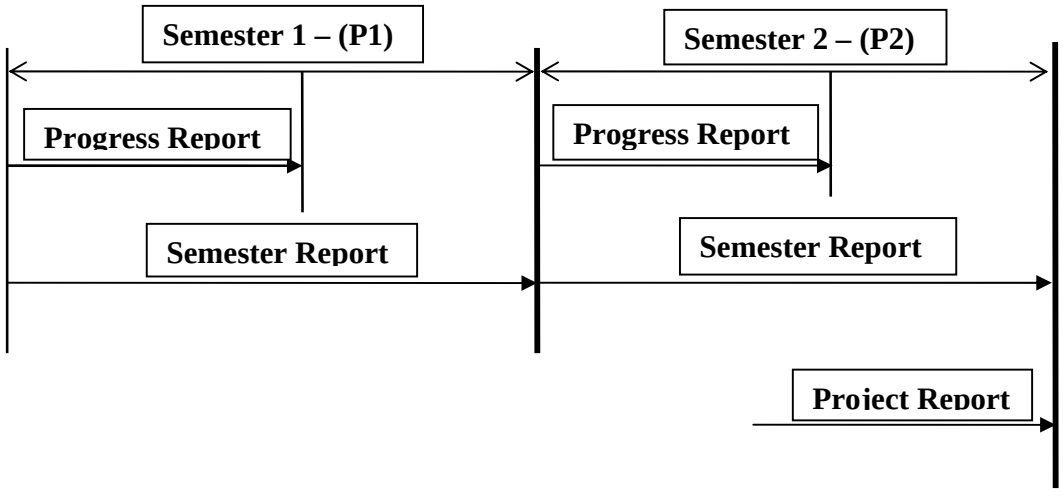
1.3.7.1 Geotechnical applications
The student should be subjected to site investigations from the planning stages through to sampling, soil testing (all soil tests) and compiling the final report

1.3.7.2 Bitumen and asphalt for road construction
Aggregates for road construction and concrete
Concrete - slump test, cube crushing strength, core crushing

1.3.7.3 Water
Testing fluids for mass density, viscosity, surface tension, capillarity, pH, conductivity, etc
Water quality assessment
Measurement of humidity, rainfall, infiltration and permeability of soil, evaporation, surface runoff and yield of boreholes

2. EVALUATION OF WORK INTEGRATED LEARNING

Students **must** compile regular reports (i.e. every 3 months) which focus on important educational experiences, i.e. what they have **done** and what they have **learned**. The following flow diagram indicates during which periods and when which reports should be compiled and submitted:



Reports must be submitted to the Vaal University of Technology not more than one (1) month after the period which the report covers, has expired. A student will there for eventually submit five (5) reports to the Vaal University of Technology during the one (1) year of Work Integrated Learning, i.e. two (2) progress reports (3-5 pages each), two (2) semester reports (5-7 pages each) and one (1) project report (4-6 pages). All these can be enhanced by including photographs and examples of learning activities that took place, added as addendums to the reports. If the student can appear in some of the photos, so much the better. The semester report will include the contents of the progress report for that semester. The semester reports must be accompanied by the evaluation documents indicating the result (%) given by the mentor/supervisor; without this the result of the student's Work Integrated Learning for that period cannot be recognised or published. The project report (section 1.1) should be submitted towards (or at) the end of P2.

Every report must have a cover page, clearly indicating:

All the **relevant student information**, i.e. initials, surname, signature, student number, name of diploma (field of study at the Vaal University of Technology), company, mentor/supervisor, signature, contact tel. no., etc.

Which **report** it is, i.e. either which progress report or which semester report or project report.

Which **period** this report covers, i.e. from which date (dd-mm-yy) till which date (dd-mm-yy).

The student's performance must be evaluated by competent officials in industry by **evaluating** these reports. In doing so, the mentor/supervisor has to judge qualities of the student such as:

Presentation / rhetoric skills, verbal reporting, ability to organise, ability to make judgement, creativity, flexibility, working pace, working quality / end results, reliability, ability to withstand stressful situations, independence and initiative, teamwork, readiness to carry responsibility, assertiveness, open-mindedness.

In compiling the progress reports and semester reports, the student must report **under the headings of the seven major categories** as listed in the syllabus guide (section 1.3), focusing on the functional elements listed below in each category in which he/she has gained experience. The scope of the functions, together with the minimum level of skill at which each was performed, must satisfy the Employer's and the Vaal University of Technology's requirements. Phrases such as "involved in" or "worked with" should preferably not be used; detailed information is required.

The functional elements are as follows:

Technological knowledge: Training requiring the application of (proven and new) technological knowledge (although perhaps sometimes in a limited field).

Manipulative skills: Training on the execution of tasks and projects requiring the effective handling, maintenance, and setting up of a reasonable variety of measuring apparatus and "tools" which are peculiar to civil engineering or a combination of engineering disciplines.

Mental skills: Training requiring the application of mental skills for the solution of a variety of practical and/or technical problems which include most of the following elements:

Diagnosis and tracing of faults

Experimental investigation

Design and development

Communication skills: Training requiring the application of communication skills which utilise (most of) the following elements:

Planning and preparation of civil engineering drawings, work instructions, specifications and civil engineering documentation;
Preparation of cost estimates and work schedules in respect of (smaller) projects;
Planning and preparation of instruction manuals for new equipment and/or procedures;
Planning and writing reports on experimental and/or literature investigations;
Planning, preparing and presenting progress and completion reports in respect of projects;
Planning and active participation in (internal) discussions, seminars, exhibitions and/or presentation of courses.

Personal and Interpersonal skills: Training creating opportunities for personal development, independent action and increasing responsibility which includes the various aspects of interpersonal relationships with subordinates, peers and superiors.

Supervisory and Management skills: Training during which the basic elements of management namely planning, action and control can be exercised, at least with regard to the allocation of your own time and the co-ordination of the work of a small group of persons (e.g. with regard to a project).

A general guideline should be that the functional elements should not be practised only in a narrow specialised area of civil engineering, but should be of such variety that they are common to a number of the possible posts available to engineering technicians within the particular company.

Functional descriptions of Work Integrated Learning must, therefore, be as complete as possible and must include the level of functional work with associated dates and changes of assignments.

The Vaal University of Technology may expect a student to present himself/herself for an interview in order to ascertain whether the training is according to the required standard and that it has been correctly documented in the evaluation forms.

2.1 ROAD MAP TO SITE

A neat and clearly detailed sketch map, which could include a descriptive directory, showing directions on how to reach the student's location of placement by road showing route numbers of all major roads and street names in the local vicinity of the site/office must be compiled by the student as soon as he/she starts with Work Integrated Learning. This map must be submitted to the undersigned as a first priority - to be evaluated and used for the monitoring visit by a Vaal University of Technology staff member. Failure to do so or incomplete map details will result in disqualification.

2.2 WORK INTEGRATED LEARNING DIARY

The student should keep a diary to record **what was done** and **what was learned**. In doing so, a typical daily report of the following could be of benefit for eventually compiling the compulsory progress and semester reports of a student e.g. on a construction site:

Date, Weather condition, Construction Plant on site you are involved with, Materials received, Work in progress, Tasks performed, Site Instructions received, Problems encountered and Solutions found, What you have learned, Technical and Manipulative Skills gained, etc.

3. CONCLUSION

This document has been devised with the intention for the guidance of both student and employer during the Work Integrated Learning period. We hope that this will contribute to the interaction between the employer, student and the Vaal University of Technology. We are all stakeholders in the co-operative education business and positive contributions are always welcome to facilitate continuous improvement.

Please feel free to contact the following person, should any problems or questions arise:

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