

Fract[ure]al Platform Building at Menlyn

by Jané Pretorius

Submitted in partial fulfilment of the requirements for the degree
Master of Architecture (Professional)
Department of Architecture
Faculty of Engineering, Built Environment and Information Technology
University of Pretoria

Study Leader & Course Coordinator: Jacques Laubscher (Dr)

Pretoria

2011

Full dissertation title:	Fract[ure]al: Platform Building at Menlyn
Submitted by:	Jané Pretorius
Student number:	26049423
Study leader & course coordinator:	Jacques Laubscher (Dr)
Degree:	Master of Architecture (Professional)
Department:	Department of Architecture
Faculty:	Faculty of Engineering, Built Environment and Information Technology
University:	University of Pretoria

PROJECT SUMMARY

Programme:

Platform building for Gautrain station at Menlyn

Site description:

Menlyn Intermodal Transport Exchange

Client:

Gautrain Rapid Rail Link

Users:

Users of the Gautrain and the Menlyn Intermodal Transport Exchange, staff of the Menlyn Intermodal Transport Exchange and the general public

Site Location:

Erf 69, Menlyn

Address:

Corner of Frikkie de Beer Street and Dallas Road, Menlyn, Tshwane, South Africa

GPS Coordinates:

25°78'49.57"S, 28°28'06.35"E

Architectural Theoretical Premise:

Chaos theory, fractals and small-world networks

Architectural Approach:

Emphasize Menlyn as a node in Tshwane and integrate the various transport systems present in the Menlyn precinct.

Research Field:

Urbanism and human settlements



ILLUS. 1.1: Queen Anne's Lace plant as an example of fractals within nature.

FRACTAL

Noun

- A curve or geometrical figure, each part of which has the same statistical character as the whole. **THEY ARE USEFUL IN MODELLING STRUCTURES IN WHICH SIMILAR PATTERNS RECUR AT PROGRESSIVELY SMALLER SCALES**, and in describing partly random or chaotic phenomena such as crystal growth and galaxy formation.

Adjective

- Relating to or, of the nature of a fractal, or fractals: fractal geometry.

~ Oxford Dictionaries, 2011.



ILLUS. 1.2: X-Ray of a fractured arm.

FRACTURE

Noun

- The cracking or breaking of a hard object or material.
- A crack or break in a hard object or material, typically a bone or a rock stratum.
- The physical appearance of a freshly broken rock or mineral, especially as regards the shape of the surface formed.

Verb

- Break or cause to break.
- Sustain a fracture.
- Split or fragment within an organisation and become unable to function or exist
- **FALTERING AND FULL OF MISTAKES; BROKEN.**

~ Oxford Dictionaries, 2011.

Met dank aan my Skepper.

Dankie aan
my ouers, Herman en familie,
CJ en sy familie,
my vriende,
Jacques en Michelle se ma wat my ondersteun en in my glo.

In accordance with Regulation 4(e) of the General Regulations (G.57) for dissertations and theses, I declare that this dissertation, which I hereby submit for the degree Master of Architecture (Professional) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

I further state that no part of my dissertation has already been, or is currently being, submitted for any such degree, diploma or other qualification.

I further declare that this dissertation is substantially my own work. Where reference is made to the works of others, the extent to which that work has been used is indicated and fully acknowledged in the text and list of references.

The dissertation is 15 800 words long (excluding the scanned items).

Jané Pretorius

TABLE OF CONTENTS

PROJECT SUMMARY	iii	2.2.2 DESIGN INTENT	23	5.2.2 MENLYN NODE URBAN DEVELOPMENT FRAMEWORK (MNUDF)	46
FRACTAL	v	2.2.3 AIMS AND OBJECTIVES OF THE REMAINDER OF THE STUDY	23	5.2.3 MENLYN NODE SPATIAL DEVELOPMENT FRAMEWORK (MNSDF)	46
FRACTURE	v				
TABLE OF CONTENTS	viii				
LIST OF ILLUSTRATIONS	x	CHAPTER 3 - THEORETICAL ARGUMENT	24	5.3 PROPOSED TRANSPORT FRAMEWORK	48
LIST OF TABLES	xv	3.1 COMPLEX SYSTEMS	24	5.4 DESIGN PRINCIPLES APPLIED TO NEW MENLYN NODE FRAMEWORK	50
		3.2 CHAOS THEORY	25	5.5 NEW MENLYN NODE FRAMEWORK	52
CHAPTER 1 - INTRODUCTION	1	3.3 FRACTALS	26		
1. INTRODUCTION	1	3.4 SMALL-WORLD NETWORKS	28	CHAPTER 6 - DESIGN DEVELOPMENT	56
1.1 PROBLEM STATEMENT	2	3.5 CONCLUSION	28	6.1 APRIL - FINAL PROJECT PROPOSAL AND CONCEPT	57
1.2 BRIDGING THE FRACT[URE]	2			6.2 MAY - CONCEPT DEVELOPMENT	58
1.3.HYPOTHESIS	4	CHAPTER 4 - CASE STUDIES & PRECEDENTS	30	6.3 JUNE - DESIGN (SKETCH PLAN STAGE)	59
1.4 LITERATURE	4	4.1 GAUTRAIN SANDTON STATION	32	6.4 JULY - DESIGN (ADVANCED SKETCH PLAN STAGE)	60
1.5 METHODOLOGY	6	4.2 SANDTON CONVENTION CENTRE	34	6.5 AUGUST - TECHNICAL 1	61
1.5.1 RESEARCH METHODOLOGY	6	4.3 PALAIS DE JUSTICE	36	6.6 SEPTEMBER - TECHNICAL 2	62
1.5.2 DELIMITATIONS	6			6.7 DISCOVERIES AND NEW PERSPECTIVES	63
		CHAPTER 5 - URBAN FRAMEWORK	38		
CHAPTER 2 - REVIEW & REASONING	8	5.1 MENLYN NODE ANALYSIS	38	CHAPTER 7 - DESIGN SOLUTION	64
2.1 BACKGROUND	8	5.1.1 CURRENT LAND USE	39	7.1 ACCOMMODATION LIST	66
2.1.1 CONTEXT	10	5.1.2 GREEN STRUCTURE	39	7.1.1 GROUND FLOOR (PUBLIC)	66
2.1.2 THE INFLUENCE OF THE MOTOR VEHICLE ON CITY LAYOUT	12	5.1.4 VEHICULAR MOVEMENT	41	7.1.2 FIRST FLOOR (SEMI-PUBLIC/PRIVATE)	66
2.1.3 ESTABLISHMENT OF MENLYN AS A NODE	12	5.1.3 SWOT ANALYSIS	41	7.1.3 SECOND FLOOR (PRIVATE)	67
2.1.4 MODES OF TRANSPORT	14	5.2 EXISTING FRAMEWORKS	44	7.2 FINAL DESIGN	68
2.2 MOTIVATION	22	5.2.1 TSHWANE REGIONAL SPATIAL DEVELOPMENT FRAMEWORK: EASTERN REGION (TRSDF)	44		
2.2.1 TRANSIT ORIENTED DEVELOPMENT	23				

CHAPTER 8 - TECHNICAL RESOLUTION	72
8.1 MATERIALS	72
8.1.1 CONCRETE	72
8.1.2 SEMI-TRANSPARENT PHOTOVOLTAIC GLASS	74
8.1.3 METAL FABRIC	75
8.2 STRUCTURAL SYSTEM	76
8.3 METAL FABRIC BOX-LIKE STRUCTURE	78
8.4 CIRCULATION	81
8.5 VENTILATION	82
8.6 DRAINAGE & SOLAR ENERGY	83
8.7 ELEVATIONS	84
8.8 SITE PLAN	85
8.9 GROUND FLOOR PLAN	86
8.10 FIRST FLOOR PLAN	88
8.11 SECOND FLOOR PLAN	90
8.12 ROOF PLAN & DETAIL	92
8.13 OTHER	95
8.14 SECTION AA	96
8.15 LESSONS I LEARNED AS AN ARCHITECTURE STUDENT	98
REFERENCES	99
APPENDIX A	102
APPENDIX B	108
APPENDIX C	112
APPENDIX D	114

LIST OF ILLUSTRATIONS

ILLUS. 1.1: Queen Anne's Lace plant as an example of fractals within nature. www.google.images.com . Edited by author, 2011.	v
ILLUS. 1.2: X-Ray of a fractured arm. www.learningradiology.com . Edited by author, 2011.	v
ILLUS. 1.3: Taxis on sidewalk of Atterbury Road. Author, 2011.	2
ILLUS. 1.4: Pedestrians jaywalking on Atterbury Road. Author, 2011.	2
ILLUS. 1.5: Bus shelter on Atterbury Road. Author, 2011.	2
ILLUS. 1.6: Road network of Menlyn area contributes to a fractured experience of the area. Author, 2011.	3
ILLUS. 1.7; Entrance to Union Station at Los Angeles' Gateway Center. www.google.earth.com . Edited by author, 2011.	4
ILLUS. 1.8: Aerial photograph of Gateway Center. www.google.earth.com . Edited by author, 2011.	4
ILLUS. 1.9: Bus Stop at Dundee Central Bus Exchange. www.nsarchitects.com/BCPT.html . Edited by author, 2011.	4
ILLUS. 1.10: Aerial photograph of Dundee Central Bus Exchange. www.google.earth.com . Edited by author, 2011.	4
ILLUS. 1.11: Hoenheim-Nord Station. www.archnewsnow.com . Edited by author, 2011.	
ILLUS. 1.12: Aerial photograph of Hoenheim-Nord Station. www.google.earth.com . Edited by author, 2011.	
ILLUS. 1.13: Context plan. Author, 2011.	6
ILLUS. 2.1: Greater context indicating urban nodes, stations and surrounding suburbs. Author, 2011.	8
ILLUS. 2.2: Location of proposed site. Author, 2011.	10
ILLUS. 2.3: Plan of Menlyn precinct indicating walking radii from site, existing transport and the location of the future Menlyn Gautrain Station. Author, 2011.	10
ILLUS. 2.4: Comparison of existing street layouts for Pretoria CBD (grid) and Menlyn precinct (free flowing). Author, 2011.	12
ILLUS. 2.5: Route to pedestrian stairway. Author, 2011.	14
ILLUS. 2.6: Sidewalk obstructed by infrastructure. Author, 2011.	14
ILLUS. 2.7: Pedestrian path through parking garage. Author, 2011.	15
ILLUS. 2.8: Bus shelter located on sidewalk. Author, 2011.	15
ILLUS. 2.9: Three-lane road with jaywalker. Author, 2011.	15
ILLUS. 2.10: Aerial map of route. Author, 2011.	15
ILLUS. 2.11: Hierarchal layout of roads in Menlyn; Existing informal taxi ranks and formal pedestrian crossings. Author, 2011.	16

ILLUS. 2.12: History of mini-bus taxi industry. Author, 2011.	18
ILLUS. 2.13: Lois Avenue taxi stop. Author, 2011.	18
ILLUS. 2.14: Atterbury Road taxi stop. Author, 2011.	18
ILLUS. 2.15: Plan of existing bus routes at Menlyn precinct. Author, 2011.	19
ILLUS. 2.16: BRT Route Line 2. Author, 2011.	20
ILLUS. 2.17: Plan of underground Gautrain route at Menlyn precinct. Author, 2011.	21
ILLUS. 3.1: Current Menlyn precinct transport system as complex system. Author, 2011.	24
ILLUS. 3.2: Current Menlyn precinct transport system as chaotic system. Author, 2011.	25
ILLUS. 3.3: Self-similarity of road connections across different scales. Important road networks of Africa, South Africa, Gauteng and Tshwane respectively. Author, 2011.	26
ILLUS. 3.4: Collage of images indicating self-similarities in Menlyn precinct. Author, 2011.	26
ILLUS. 3.5: Palais de Justice, Nantes (2000), by Jean Nouvel. Progression of interest at different scales. Author, 2010.	27
ILLUS. 3.6: Small-world network principles applied to design proposal. Author, 2011.	29
ILLUS. 3.7: Principle of small-world networks applied to Tshwane. Author, 2011.	29
ILLUS. 4.1: Signage outside the Gautrain Sandton Station. Author, 2011.	31
ILLUS. 4.2: Exterior of the Sandton Convention Centre. www.saconvention.co.za/SandtonConventionCentre_Venue.asp . Edited by author, 2011.	31
ILLUS. 4.3: Interior of the Palais de Justice. Author, 2010.	31
ILLUS. 4.4: Design application of Gautrain Sandton Station to the Platform Building at Menlyn. Author, 2011.	32
ILLUS. 4.5: Photo collage of Gautrain Sandton Station. Author, 2011.	33
ILLUS. 4.6: Design application of Sandton Convention Centre to the Platform Building at Menlyn. Author, 2011.	35
ILLUS. 4.7: Photo collage of Sandton Convention Centre including diagrammatic section. Author, 2011.	35
ILLUS. 4.8: Design application of Palais de Justice to the Platform Building at Menlyn. Author, 2011.	36
ILLUS. 4.9: Photo collage of Palais de Justice, including ground floor plan. Author, 2011.	37
ILLUS. 5.1: Current land use of Menlyn node. Author and Fransa van Zyl, 2011.	38
ILLUS. 5.2: Menlyn square as example of commercial use. Author, 2011.	39
ILLUS. 5.3: Old Mutual Office Park as example of business use. Author, 2011.	39
ILLUS. 5.4: Damelin College as example of educational use. Author, 2011.	39

ILLUS. 5.5: Litter in Menlyn node. Author, 2011.	39
ILLUS. 5.6: Green structure of Menlyn node. Author and Fransa van Zyl, 2011.	39
ILLUS. 5.7: Vehicular movement in Menlyn node. Author and Fransa van Zyl, 2011.	40
ILLUS. 5.8: Traffic congestion on Atterbury Road. Author, 2011.	41
ILLUS. 5.9: Development in Menlyn node - 2010. Author, 2011.	41
ILLUS. 5.10: Development in Menlyn node - 2020. Author, 2011.	41
ILLUS. 5.11: Visual context of precinct. Author and Fransa van Zyl, 2011.	42
ILLUS. 5.12: Tsošološo programme principles applied to NEW MENLYN NODE FRAMEWORK. Author and Fransa van Zyl, 2011.	45
ILLUS. 5.13: Menlyn Node Urban Development Framework. Author and Fransa van Zyl, 2011.	47
ILLUS. 5.14: Proposed underground Gautrain route. Author, 2011.	48
ILLUS. 5.15: Proposed bus routes. Author, 2011.	48
ILLUS. 5.16: Proposed taxi routes. Author, 2011.	49
ILLUS. 5.17: Proposed motor vehicular routes. Author, 2011.	49
ILLUS. 5.18: Proposed pedestrian routes. Author, 2011.	49
ILLUS. 5.19: Plan and section of a typical pedestrian boulevard. Author and Fransa van Zyl, 2011.	50
ILLUS. 5.20: Plan and section of a typical mall passage. Author and Fransa van Zyl, 2011.	50
ILLUS. 5.21: Comparison of mall and framework layout. Fransa van Zyl, 2011.	51
ILLUS. 5.22: Plan and section of event space. Author and Fransa van Zyl, 2011.	51
ILLUS. 5.23: Plan and section of public square as event space. Author and Fransa van Zyl, 2011.	51
ILLUS. 5.24: Pedestrian crossing Genl. Louis Botha Drive. Author and Fransa van Zyl, 2011.	52
ILLUS. 5.25: Pedestrian bridge at Lois Avenue. Author and Fransa van Zyl, 2011.	52
ILLUS. 5.26: Section of Dallas Road. Author and Fransa van Zyl, 2011.	52
ILLUS. 5.27: Section of Frikkie de Beer Street and Amarand Road. Author and Fransa van Zyl, 2011.	52
ILLUS. 5.28: NEW MENLYN NODE FRAMEWORK. Author and Fransa van Zyl, 2011.	53
ILLUS. 5.29: Proposed precinct development heights. Author, 2011.	54
ILLUS. 5.30: Precinct plan. Author and Fransa van Zyl, 2011.	54
ILLUS. 6.1: Menlyn Intermodal Transport Exchange planning diagrams - April. Author, 2011.	57
ILLUS. 6.2: Menlyn Intermodal Transport Exchange site plan diagrams - May. Author, 2011.	58
ILLUS. 6.3: Platform Building at Menlyn sketch plans and drawings - June. Author, 2011.	59

ILLUS. 6.4: Platform Building at Menlyn sketches, plans and drawings - July. Author, 2011.	60
ILLUS. 6.5: Platform Building at Menlyn sketch section - August. Author, 2011.	61
ILLUS. 6.6: Platform Building at Menlyn diagram, ground floor plan and first floor plan - September. Author, 2011.	62
ILLUS. 6.7: Platform Building at Menlyn section - October. Author, 2011.	63
ILLUS. 7.1: Functions indicated per level. Author, 2011.	64
ILLUS. 7.2: Sketch of Platform Building at Menlyn from South West corner. Author, 2011.	65
ILLUS. 7.3: Location of platform building on site and in relation to other transport modes. Author, 2011.	65
ILLUS. 7.4: Location of facilities in the Platform Building at Menlyn. Author, 2011.	67
ILLUS. 7.5: Parti diagram. Author, 2011.	68
ILLUS. 7.6: Platform and column-and-beam structure. Author, 2011.	68
ILLUS. 7.7: Objects on platform. Author, 2011.	68
ILLUS. 7.8: Perspective of Platform Building at Menlyn from South East corner. Author, 2011.	68
ILLUS. 7.9: Example of stereotomic vs. tectonic on second floor. Author, 2011.	69
ILLUS. 7.10: GKD metal fabric structure. Author, 2011.	69
ILLUS. 7.11: Example of grid pattern. Author, 2011.	69
ILLUS. 7.12: Ground floor plan indicating different functional areas. Author, 2011.	70
ILLUS. 7.13: South elevation of Platform Building at Menlyn. Author, 2011.	71
ILLUS. 7.14: Perspective of Platform Building at Menlyn from North West corner. Author, 2011.	71
ILLUS. 8.1: Illustration of use of concrete in design. www.lafarge.co.za and author, 2011.	72
ILLUS. 8.2: Interior view of installed semi-transparent photovoltaic glazing, location unknown. www.neutraexistence.com/blog/see-through-photovoltaic-glass/ . Edited by author, 2011.	75
ILLUS. 8.3: Construction of semi-transparent photovoltaic glazing. Author, 2008.	75
ILLUS. 8.4: Omega 1520 GKD metal fabric. www.gkdmetalfabrics.com . Edited by author, 2011	75
ILLUS. 8.5: Union theological seminary, Richmond, Virginia. www.gkdmetalfabrics.com . Edited by author, 2011.	75
ILLUS. 8.6: Doral Park, Doral, Florida. www.gkdmetalfabrics.com . Edited by author, 2011.	75
ILLUS. 8.7: Woven-in bar with spring GKD metal fabric attachment method. www.gkdmetalfabrics.com . Edited by author, 2011.	75
ILLUS. 8.8: Perspective of the structural system of the Platform Building at Menlyn. Author, 2011.	76
ILLUS. 8.9: Exploded axonometric of the structural system of the Platform Building at Menlyn. Author, 2011.	76

ILLUS. 8.10: Perspective of the metal fabric box-like structure of the Platform Building at Menlyn. Author, 2011.	78
ILLUS. 8.11: Graphic portrayal of the grid used for the metal fabric box-like structure. Author, 2011.	78
ILLUS. 8.12: Detail of metal fabric box-like structure. Author, 2011.	80
ILLUS. 8.13: Circulation routes. Author, 2011.	81
ILLUS. 8.14: Natural ventilation system. Author, 2011.	82
ILLUS. 8.15: Rainwater collection and solar energy systems. Author, 2011.	83
ILLUS. 8.16: North elevation. Author, 2011.	84
ILLUS. 8.17: South elevation. Author, 2011.	84
ILLUS. 8.18: East elevation. Author, 2011.	84
ILLUS. 8.19: West elevation. Author, 2011.	84
ILLUS. 8.20: Site plan. Author, 2011.	85
ILLUS. 8.21: Ground floor plan. Author, 2011.	86
ILLUS. 8.22: First floor plan. Author, 2011.	88
ILLUS. 8.23: Second floor plan. Author, 2011.	90
ILLUS. 8.24: Roof plan. Author, 2011.	92
ILLUS. 8.25: Glass canopy at California Academy of Sciences (2008) by Renzo Piano. www.architecture-buildings.com . Edited by author, 2011.	93
ILLUS. 8.26: Glass roof structure perspective. Author, 2011.	93
ILLUS. 8.27: Roof detail 1. Author, 2011.	93
ILLUS. 8.28: Roof detail 2. Author, 2011.	94
ILLUS. 8.29: Stair detail. Author, 2011.	95
ILLUS. 8.30: Balustrade detail. www.dorma.co.za , Edited by author, 2011.	95
ILLUS. 8.31: Perspective of section AA. Author, 2011.	96
ILLUS. 8.32: Section AA. Author, 2011.	97
ILLUS. A.1: Entrance to Bloed Street Mall & Taxi Rank. Author, 2011.	102
ILLUS. A.2: Metro Mall Transport Facility. www.urbansolutions.co.za/images/public/metro.html . Edited by author, 2011.	103
ILLUS. A.3: Philippi Public Transport Interchange. Jacqui Perrin. Edited by author, 2011.	103
ILLUS. A.4: Skinner Street Taxi Rank. Author, 2011.	103
ILLUS. A.5: Bloed Street Mall and Taxi Rank lower ground floor sketch plan and circulation plan. Author, 2011.	104
ILLUS. A.6: Metro Mall Transport Facility and Traders Market ground floor sketch plan and circulation plan. Author, 2011.	105

ILLUS. A.7: Philippi Public Transport Interchange site sketch plan and circulation plan. Author, 2011.	105
ILLUS. A.8: Skinner Street Taxi Rank site sketch plan and circulation plan. Author, 2011.	105
ILLUS. A.9: Facilities and section of interface at Bloed Street Mall and Taxi Rank. Author, 2011.	106
ILLUS. A.10: Facilities and section of interface at Metro Mall Transport Facility and Traders Market. Author, 2011.	107
ILLUS. A.11: Facilities and section of interface at Philippi Public Transport Interchange. Author, 2011.	107
ILLUS. A.12: Facilities and section of interface at Skinner Street Taxi Rank. Author, 2011.	107
ILLUS. B.1: Illustration of structural column. Orton (1987: 30-54).	108
ILLUS. B.2: Illustration of reinforced two-way slab. Orton (1987: 30-54).	108
ILLUS. B.3: Illustration of reinforced one-way solid slab. Orton (1987: 30-54).	109
ILLUS. B.4: Illustration of steel column. Orton (1987: 30-54).	109
ILLUS. B.5: Illustration of steel roof. Orton (1987: 30-54).	109
ILLUS. B.6: 2 500l Horizontal Jojo water storage tank. www.jojotanks.co.za. Edited by author, 2011.	111
ILLUS. C.1: Erythrina Lysistemon. www.frangipanieurop.com. Edited by author, 2011.	112
ILLUS. C.2: Harpephyllum Caffrum. www.wildcard.co.za. Edited by author, 2011.	112
ILLUS. C.3: Syzygium Cordatum. www.wildcard.co.za. Edited by author, 2011.	113
ILLUS. C.4: Euclea Crispa subsp. www.plantdiversityofsaudi Arabia.info. Edited by author, 2011.	113
ILLUS. C.5: Heteropyxis Natalensis. www.inheemseboome.co.za. Edited by author, 2011.	113
ILLUS. D.1: Results of SBAT applied to Platform Building. Author, 2011.	115
ILLUS. D.2: View from North East corner. Author, 2011.	116
ILLUS. D.3: Southern side of model. Author, 2011.	117
ILLUS. D.4: Approach from South. Author, 2011.	117
ILLUS. D.5: Aerial view of model. Author, 2011.	117

LIST OF TABLES

TABLE 2.1: Comparison of city block sizes, accessibility and users. (Author, 2011)	12
TABLE 2.2: Hierarchy of roads (Conversation with Pretorius, C., 2011.)	17
TABLE 2.3: Travel times to work (National Household Survey, 2007: 30).	20
TABLE B.1: Sanitary requirements.	110
TABLE B.2: Water storage tank calculations.	111

“The first qualification for judging any piece of workmanship from a corkscrew to a cathedral is to know *what* it is - what it was intended to do and how it was meant to be used. After that has been discovered the temperance reformer may decide that the corkscrew was made for a bad purpose, and the communist may think the same about the cathedral. But such questions come later. The first thing is to understand the object before you: as long as you think the corkscrew was meant for opening tins or the cathedral for entertaining tourists you can say nothing to purpose about them” (Lewis, 1942: 1).