UNIVERSITI TEKNOLOGI MARA

A CASE STUDY ON RADIATE METHOD IN ON-LINE METHOD IN CADASTRAL ADJUSTMENT

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BSc

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NUR ALIA BINTI AMIRUDIN

Thesis submitted in fulfilment
Of the requirements for the degree of
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CONFIRMATION BY PANELS OF EXAMINERS

I certify that the Panels of Examiners has met on 27 July 2020 to conduct the final examination of Nur Alia Binti Amirudin on his **Bachelor of Surveying Science and Geomatics (Hons)** thesis entitled "A Case Study on Radiation Method and On-Line Method in Cadastral Adjustment" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panels of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

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AUTHOR'S DECLARATION

I declare that the work in this report was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged a referenced work. This report has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

Radiation method one of cadastral observation method where is suitable for locating boundary marks which are within a single tape length (from the location of plane table) and on-line method is a situation where a boundary marks are parallel towards other boundary marks. This method usually performed during the land title of property especially terrace house. However, there is an improvement when using these two methods in terms of geometry data checking during field observations since LSA only fulfil certain condition using these two methods. This paper highlight issues on how to apply radiation method and on-line method in cadastral survey observation method. In order to solve the aim of this study, there are three objectives need to be achieved which is to study the variations of impact when performing radiation in on-line method and to propose the new standard procedure relating to the issue given. The result of this study will be a new guideline for radiate method in on-line method and to find the suitability of using these two methods.

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Firstly, I wish to thank God for giving me the opportunity to embark on my degree and for completing this long and challenging journey successfully. My gratitude and thanks go to my supervisor Sr Norshahrizan Mohd Hashim, and co-supervisor, Sr Mohamad Asrul Mustafar . Thank you for the support, patience and ideas in assisting me with this project. I also would like to express my gratitude to the Department of Survey and Mapping Malaysia providing the facilities, knowledge and assistance.

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for helping me with this project.

Finally, this thesis is dedicated to the loving memory of my very dear father and mother for the vision and determination to educate me. This piece of victory is dedicated to both of you. Alhamdulilah.

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Abbreviations

LSA	Least Square Adjustment	Least Square Adjustm
DSMM	Department of Survey and Mapping Malaysia	Department of Survey
NDCDB	National Digital Cadastral Database	National Digital Cada
CRM	Cadastral Reference Marks	Cadastral Reference M
GNSS	Global Navigation Satellite System	Global Navigation Sa
3D	Three-Dimension	Three-Dimension
CCS	Coordinated Cadastral System	Coordinated Cadastra
RSO	Rectified Skew Orthomorphic	Rectified Skew Ortho
DIC	Double Independent Check	Double Independent C

CHAPTER ONE
INTRODUCTION

1.1 Introduction

This chapter explained the research background, problem statement, aim and objectives, research questions, scope and limitations of research, significance of study and chapter outline.

1.2 Research Background

1.2.1 Radiation Method

There are several methods in plane surveying that are available in order to acquire the data collection such as intersection method, traverse and radiation method. The main focus in this research are radiation method. In the plane table radiation survey method, the path of the objects or points to be located is obtained by drawing radial lines along the fiducial edge of the alidade after the objects or points are bisected along the alidade's line of sight. This method only suitable for the small areas and one of method that stated by Ketua Pengarah Ukur dan Pemetaan Circular Bil 5/2009. Figure 1 shows that procedure to collect the data using the radiation method.

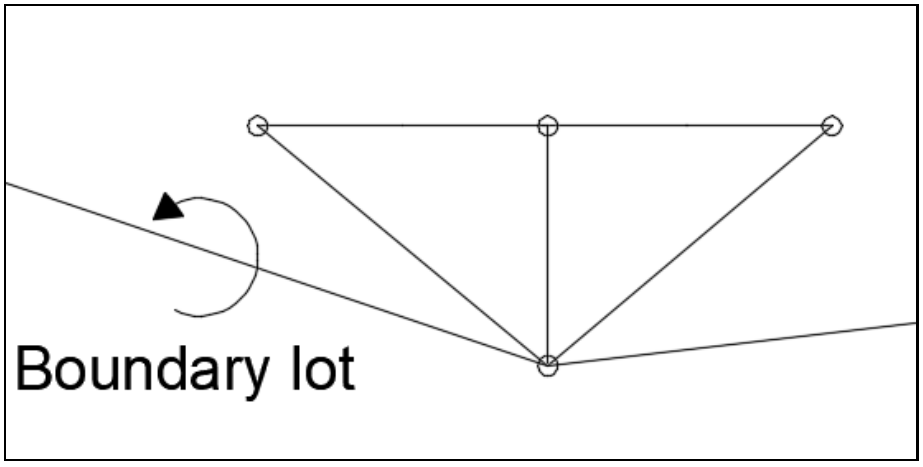


Figure 1.1 Radiation method

1.2.2 On-Line Method

On-line method is a situation where a boundary marks are parallel towards other boundary marks. This method can used when to planted a new boundary marks as stated in Pekeliling Ketua Pengarah Ukur Dan Pemetaan Circular Bil. 3 Tahun 2003 until boundary marks is proven in right position. This usually happen at terrace housing area. Figure 1.2 shows that on-line method that usually implement.

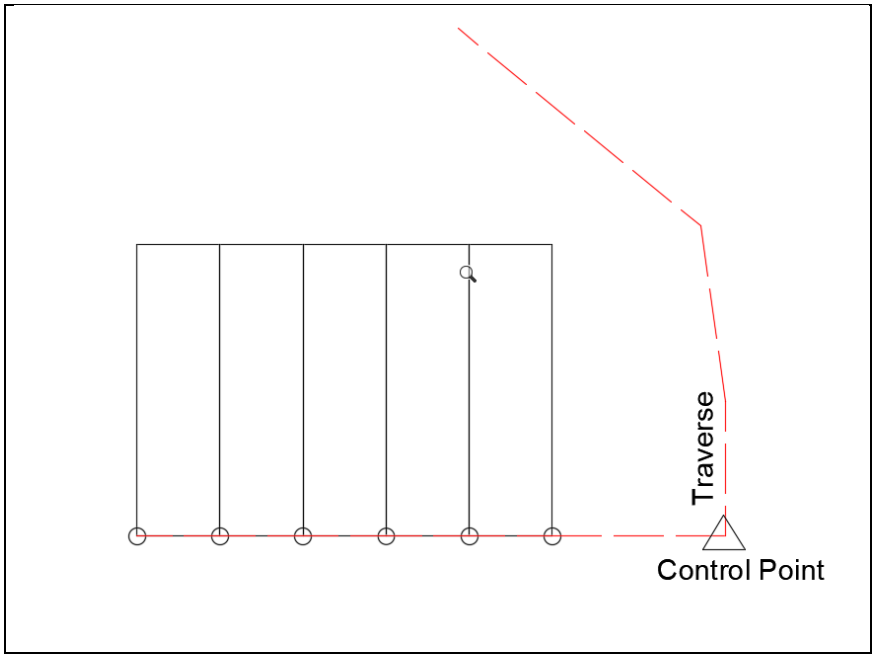


Figure 1.2 Online method

1.2.4 Intersection Method

This method the plane table is shifted to a known distance in a particular direction marked on the ground and the line of sights are drawn to make intersection of the radial lines already drawn from the first set up of the instrument. Bearing and distance observations should be made from two different traverse station with a circle only. This method is useful where it is not possible to measure the distances on ground as in case of a mountainous country. Hence, this method is employed for locating inaccessible points, the broken boundaries, rivers, fixing survey stations

1.2.3 Bowditch Adjustment

Bowditch adjustment is a method used to adjust the control points before replacing them with Least Square Adjustment (LSA). Bowditch is a conventional method defined as an arbitrary method where all error estimates in linear measurements and angular measurements are equal to the perimeter line (Yunus, Yusoff, Jamil, Zurairah, & Halim, 2013) . The correction Bowditch method is applied based on their uncertainties.

Least Square Adjustment is an adjustment used in traversing method where used the mathematical model probability where basically other method did not have this meticulous base. The sum of the squares of the errors times in minimized based on their respective weights. Another aspect of least squares adjustment allowed all observations even though different number or type can make an adjustment and used simultaneously in the computation. Hence, and adjustment can be made by can combine all the data type such as distances, horizontal angles, azimuths, zenith or vertical angles, height differences, coordinates, and even GPS observations (Ghilani & Wolf, 2006).

However, according to findings shows that not all of the cadastral observation method is suitable with the LSA adjustment especially with the radiation method in on-line since there are some are using argue that Bowditch one of adjustment that are still widely used in cadastral surveying (Leahy, 1977).

1.3 Problem Statement

Bowditch method is method to adjust errors in bearings due to angular or linear inaccuracies where it assumes all of observations are done to the same degree of precision and the misclosures could be logically distributed within the survey. While least square adjustment (LSA) is an adjustment that made solution of an overdetermined system of equations. A least square adjustment widely used in survey field due to its capability to determine if a survey meets acceptable tolerances or whether the observations must be repeated (Ghilani & Wolf, 2006).

However, not every measurement method is suitable using LSA method since LSA only fulfil certain condition regarding geometry checking. Bowditch adjustment provided a geometry checking since as common to all non-least square adjustments, any of adjustment will adjusting the angles first and the geometry will be enforced so that their sum is correct (Sprinsky, 1987). This paper focusing on issues of radiation method in on-line method in cadastral survey observation method. Currently, there is no geometry data checking procedure when performing of radiation method in on-line method Department of Survey and Mapping Malaysia (DSMM). Thus, this research can be an enhancement for on-line method procedure while showed the necessity of geometry data checking during cadastral survey.

1.4 Aim and Objectives

The aim of this study is on how to apply the radiation method in on-line method in Least Square Adjustment environment.

Based on aim above, the objective as follow:

i. To study the impact of on-line method based on single leg.
ii. To study the on-line method based on geometry data checking procedure using double independent check (DIC) and intersection method.
iii. To propose the new suggestion method procedure of geometry data checking procedure during emplace boundary marks.

1.5 Research Question

The main objective of this study is to impact of radiation and online method in terms of geometry checking in least square adjustment environment. In order To achieve this main objective, some sub-objectives can be formulated:

i. What is the impact of on-line method based on single leg in LSA?
ii. What is the result of using on-line method if geometry data checking procedure performed using double independent check (DIC) and intersection method?

iii. How to apply a new method of procedure for using radiation and on-line method in least square environment?

1.6 Scope and Limitation of Research

This subsection will explain the scope of work and limitation of the research.

1.6.1 Scope of Work

This study focused on the radiation and on-line method when emplace, replace and removed the boundary marks using these two methods. This case study is to find out the impact differences distance of using radiation and on-line method toward least square environment.

This study intended to cadastral practitioner, and the ins and out of this method, when performing these two methods on land surveying.

Furthermore, it only attempted to study the impact of radiation and on-line method and to propose the standard of procedure of geometry checking during emplace boundary marks using radiation method and on-line method.

1.6.2 Limitations and Challenges of Research

This case study has potential limitations. First, as in most observational studies, the work discussed here has been constrained by the methods used and time limitation. Second, a pandemic has occured that have been prevent for data acquisition. Last but not least, results of this study may not be completely generalizable because of the sample size and using a simulation data which is may be vary from a real work data.

1.7 Significance of Study

Since cadastral field required an accuracy in every observation made to be store into National Digital Cadastral Databases (NDCDB), a geometry data checking procedure must be conducted to make sure any of boundary marks should be within allowable tolerance when using radiation method and on-line method. According

to section 369 (1) (a) in National Land Code (NLC) stated that, any boundaries should be determined by right-lines to ensure that any of surveying works should be conduct in manner which survey is to be carried out. By proposing a new standard of procedure when conducting field observation radiate method for setting out the terrace housing lot, a new geometry checking procedures should be conducted by licensed land surveyor practitioner to ensure that the position of boundary marks should be in right position and in allowable tolerance.

1.8 Chapter Outline

In chapter one for Introduction will present the overall planning framework such as research background, problem statement, aim and objectives, research questions, scope and limitations of research, significance of study for this case study.

In chapter 2 for literature review, this chapter present a review and synthesis of methodology and findings in some of the main studies of using LSA conducted in the past.

Next, for the chapter 3 which is Methodology highlighted planning and procedure to approach the research questions from chapter 1. The data acquisition also explained in this chapter.

Then, chapter 4 outline the result and analysis can be made from the data acquisition and any findings that can be found in chapter 3. Last but not least, chapter 5 presents a discussion of the finding in the present thesis as well as the implications in a wider planning content, in order to provide suggestions for how to improve decision-making.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter explain a review based on previous methodology and findings in related studies specific to radial method in on-line, cadastral survey, observation method, e-cadastre, issues have been highlighted in least square adjustment environment.

2.2 Cadastral Survey

Cadastral surveying is the cadastral and a survey sub-field and is specialized in establishing and re-establishing boundary marks in real-property boundaries for final output which is the final title. This is an essential component of lawful property development.

2.3 Observation Method in Bowditch Environment

2.3.1 Traverse Method

Traverse in Bowditch adjustment is a system where irregularities in bearings may be modified due to angular or linear inaccuracies, as it believes all measurements are always performed to the same degree of accuracy and misclosures may be applied logically. In Bowditch adjustment, C-correction is applying to balance the angle and traverse adjustment. In this state, if there is no gross errors occurs in the angles and all the systematic effect have been eliminated by instrument calibration, careful levelling and careful instrument and target centring (Walker & Awange, 2018).

The adjusted bearing shows that Bowditch method forced to do a correction and the violence Bowditch does to the bearings caused serious shortcoming of the method (Bird, 1972). As jump into conclusion least squares produces

more reasonable results, particularly if the final bearings are to be used to control further work.

2.3.2 Double Independent Check (DIC)

According to Chief of Surveying and Mapping Circular Volume 3 Year 2003, subsection 3.1.3 stated that checking of angle and distance to the boundary mark as necessary performed for boundary lines and extension lines hanging unless there are values sufficient old measure to prove the position of the boundary mark is in original state. All line distance measurements need to be checked either in gradual observation (part by part) or with change the vertical angle or even made according to the direction opposite.

2.4 Observation Method in Least Square Adjustment Environment

2.4.1 Traverse Method

Taking into account a full statistical interpretation of the findings can be made traverse method of observation in the LSA context. Specific checks can be carried out depending on the sizes and distribution of the errors to determine if a sample exceeds appropriate tolerances or if the results need to be replicated. This can be identified and deleted if there are blunders in the results. Traverse in LSA are differ than Bowditch because of LSA permits all observations, regardless of their number or type, to be entered into the adjustment and used simultaneously in the computations (Ghilani & Wolf, 2006).

2.4.2 Radiate

Radiate is a method of plane table surveying where direction of the objects or point located are obtained by drawing radial lines along fiducially edge

of alidade after getting the objects or points bisected along the line of sight of the alidade. According to Circular of Director of Survey and Mapping (DSSM) No 6 Year 2009, radiate method can be used when limiting the observation distance to no more than 300 meters based on single-leg only. If the observation exceeding 300 meters, the observation needs to closed to nearest CRM or old boundary marks that been proven in actual position where the total numbers of station not more than 25 stations or astronomical observation control. Figure 2.1 shown that the acceptable condition when performing for radiate method for closed traverse. The radiate from station 4, 6 and 8 are allow when the traverse are closed to the station 10 (cyan line).

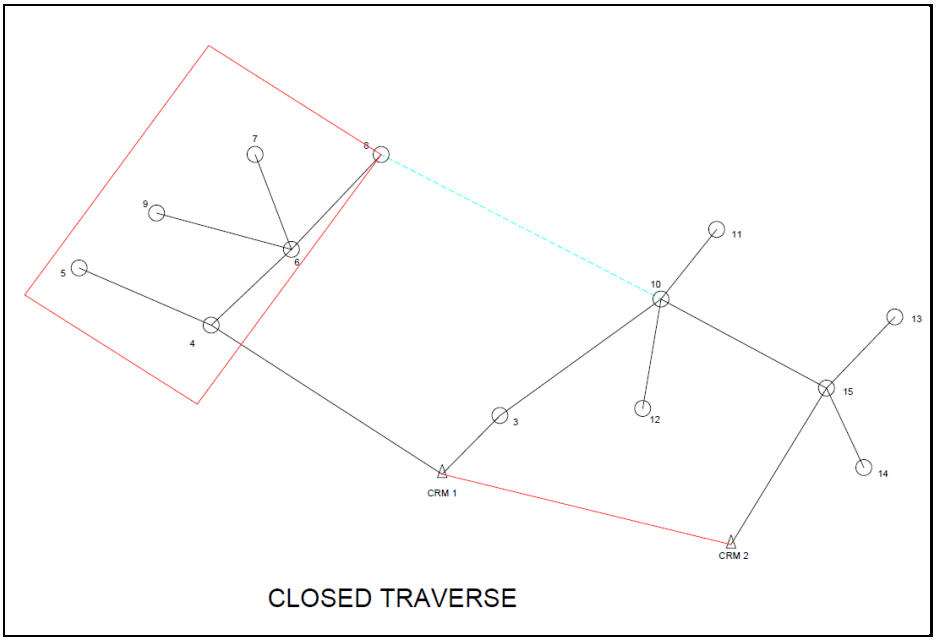


Figure 2.1 Condition for radiate in closed traverse

For open traverse, radiate for station 4 and station 6 are allow when traverse is closed to the station 9 which is station should be CRM, Coordinated Cadastral Infrastructure (CCI) or NDCDB.

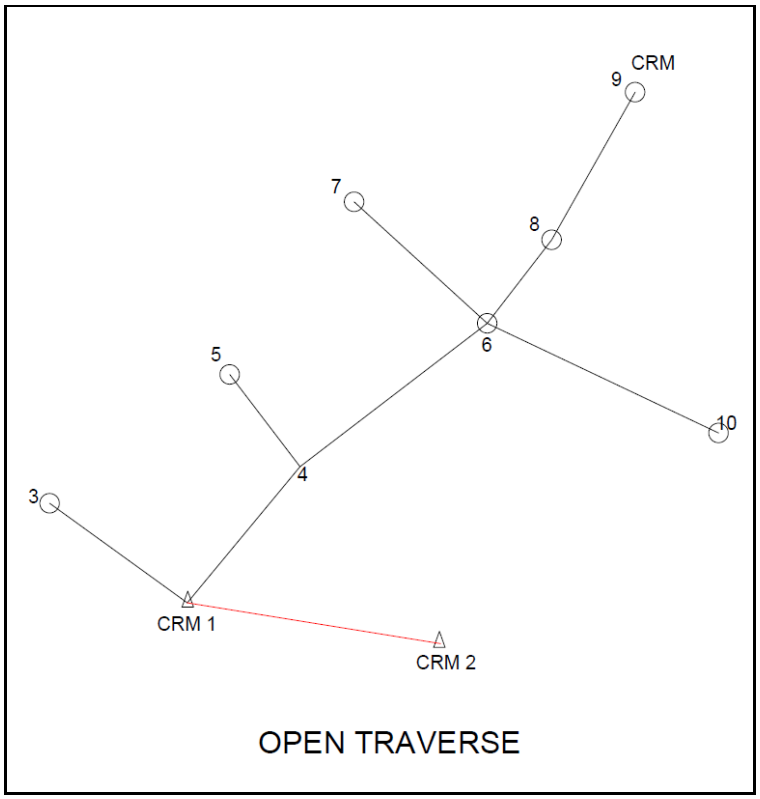


Figure 2.2 Radiate for open traverse

2.4.3 Intersection

Intersection method of plane surveying are the objects or point to be located are obtained at the point of intersection of radial lines drawn from two different stations. The intersection method is suitable when distances of objects are large or cannot be measured properly. Thus, this method is preferred in small scale survey or mountainous regions. This method also are possible to obtain the coordinate of an unknown station geometrically (Fiadeiro, 1987). According to Circular of DSSM No 6 Year 2009 stated that observation of bearing and distances are observed from two different station of traverse with one face.

Figure 2.3 shown that intersection procedure. Observation must be made from two known station with known value of bearing and distance and then observed to station that need to know it position.

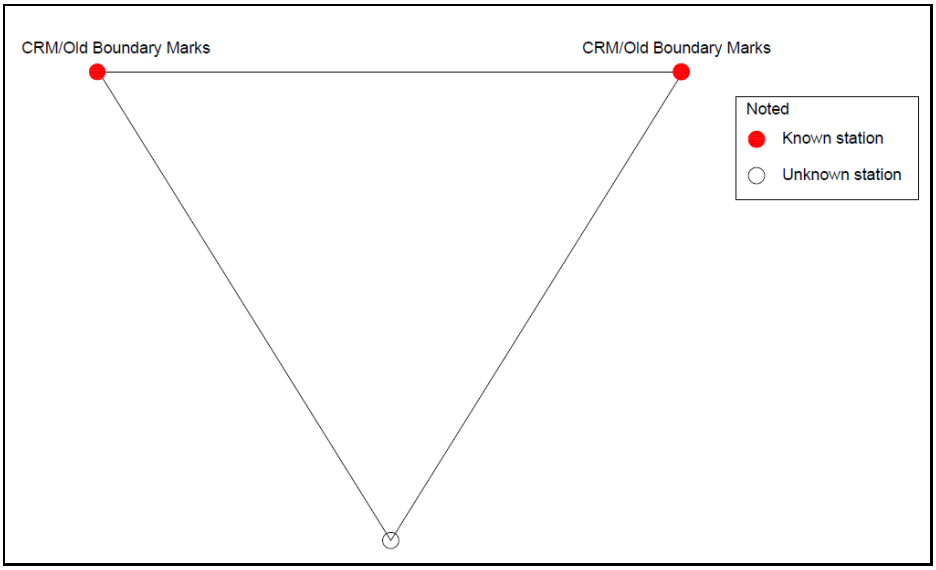


Figure 2.3 Intersection method

2.4.4 Resection

Resection is a method for determining an unknown position or position finding measured angle with respect to known position. In surveying work, the most method of computing the coordinates of a point angular are using resection method especially when the works involved with high precision surveying such as geodetic network. As for cadastral work procedure for Malaysia, DSMM has state that resection work must observed bearing and distances from different three control points with one face only. Figure 2.4 shown that procedure of using resection method. Observation must be made from unknown station to three boundary marks that have know value. The observation must record bearing and distance for of right and left face.

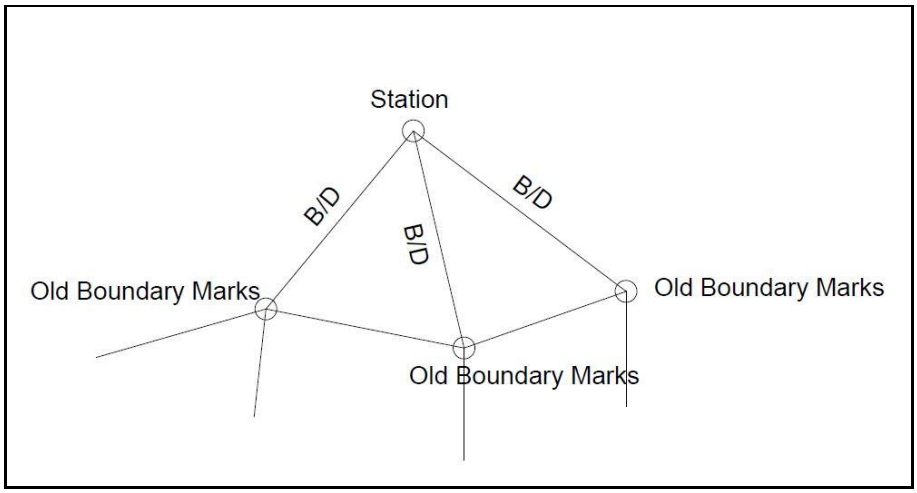


Figure 2.4 Resection method procedure

The problem of obtaining the position of an unknown point from relative angular measurements to three known points or stations is a basic operation in surveying engineering. A new theoretical approach for addressing the problem of three-point resection. The procedure is based on the straight lines intersect and connected with each of the stations to determine P's location. The absolute orientation or azimuth necessary of these lines is obtained from the geometric relationship between two identical triangles, as described in further sections (Font-Llagunes & Batlle, 2009) . This approach is an alternative to the other current three-point resection problem, and its strong performance has been proved by numerical simulations and a practical survey.

2.4.5 Global Navigation Satellite System (GNSS)

GNSS is satellite system that is used to pinpoint geographic location of a user's receiver anywhere on land and sea, in the air or in Earth orbit. In conjunction with GPS networks, GNSS is used to provide an accurate positioning everywhere on Earth. GNSS and GPS operate similarly, but the key distinction between GPS and GNSS is that GNSS-compatible hardware will use navigation satellites from other networks outside the GPS program, and further satellites contribute to the precision and durability of the

receivers. These outdated methods of carrying out accurate horizontal control surveys have been gradually replaced by the GPS. In addition, not only does GPS produce horizontal positions but it also produces ellipsoidal heights. So, three-dimensional surveys are given by GPS. Like in all remarks, the GPS results contain mistakes and need to be modified (Ghilani & Wolf, 2006).

The application of LSA in GPS can be seen when used to as online quality control of Multi-GNSS real-time clock estimation. Real-time satellite orbit and clock product is a key prerequisite for real-time precise positioning service based on precise point positioning (PPP). With the growth development of the multiple global navigation satellite systems (Multi-GNSS), there are almost 120 satellites will be processed for Multi-GNSS real-time clock estimation (Fu et al., 2019). Unfortunately, the computation is very time-consuming, especially for quality control since problematic observations are inevitable. Sequential square sequential adjustment with an adapted online quality control system is developed to quickly estimate Multi-GNSS real-time clocks, although specific filtering estimators are now commonly used.

Cycle slip detection for single frequency GNSS data is currently focused largely on measurement modeling or estimation that cannot be effectively done for kinematic applications and minor cycle slips such as half-cycle slips are difficult to detect or repair (Chen, Chen, Jiang, Zhou, & Yuan, 2018). A new technique based on the total differential of ambiguity and Least-Squares Adjustment (LSA) for cycle slip detection and repair is introduced and validated. LSA is then performed to diagnose and fix cycle slips where the coordinate and cycle slips are obtained.

2.5 e-Cadastre

e-Cadastral is a system that utilize ICT technology, GIS and current surveying is aim to expedite and to stabilize in delivery of cadaster survey system through effective integration system (Yunus et al., 2013). It involving reshuffle from conventional measurement works process from Bowditch and Transit to Survey Accurate Coordinate through Least Square Adjustment and established cadaster database called National Digital Cadastre Database and Strata Survey Database/Stratum/Marine (PDUSSM). Figure 2.5 shown that e-Cadastral application modules.

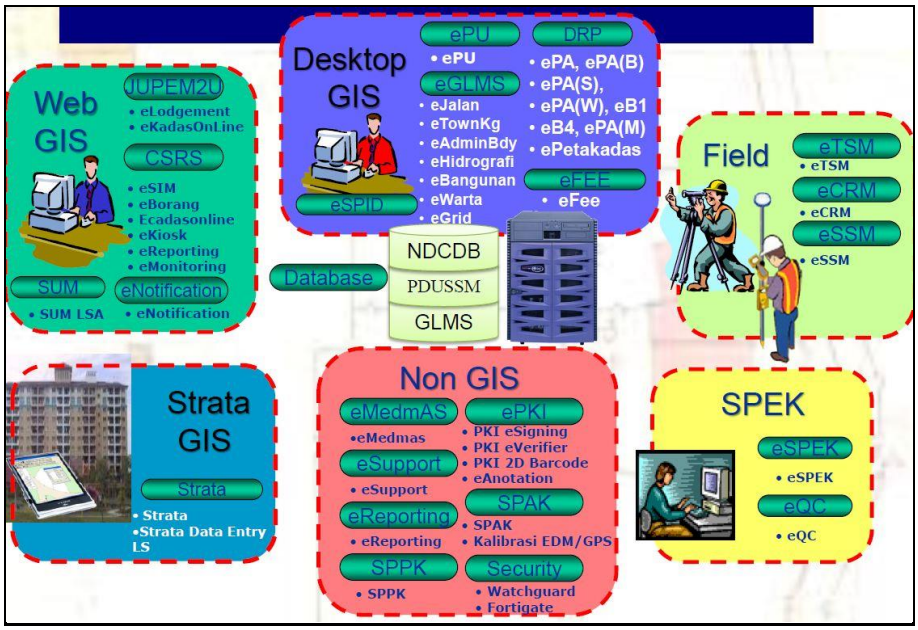


Figure 2.5 e-Cadastral modules

In 2010, DSMM introduced the eCadastre system to improve the implementation of existing cadastral surveys in Malaysia. e-Cadastre involved the modification of traditional methods from the cadastre survey into an accurate survey coordinate using the least square adjustment (Jeffri, Hisham, & Joanes, 2017). This paper stated that LSA have been used as an adjustment since all errors in measurements are considered as random errors and follow the law of normal distributions. This is supported why this research need to be conducted since there is requirement for adjustment since DSMM itself used this adjustment.

A case study has been conducted at Malaysia relating standard provides of conceptual model for recording and managing land administration data which called land administration domain model (LADM). This offers an extensible framework for the implementation and improvement of land management systems functionality and effectiveness, based on a Model Driven Architecture (MDA) which helps the participants to interact which infer the model, both within one country and between various countries. (Rajabifard et al., 2018). The inducement for this paper is to address Malaysian government's new initiative to explore the realistic road to realizing a LADM-based 3D cadastral system in accordance with Malaysia's jurisdictional settings. The paper also proposed how 3D-NDCDB's action plan, including enhancing current database and methods of data collection to promote digital data based on user requirement. These approaches will enhance the integration of complementing modules such as 3D spatial data input, 3D adjustment and validation of 3D spatial data.

2.5.1 Coordinated Cadastral System (CCS)

There are three main components in e-Cadastre to be specific Coordinated Cadastral System (CCS), Virtual Survey System and Cadastral Data Integrity System. The implementation of CCS is a major part of the e-Cadastre project that includes field and office reengineering to reduce processes and increase the use of digital technology. Figure 2.6 shown that characteristic (blue) of CCS and their aspects (white).

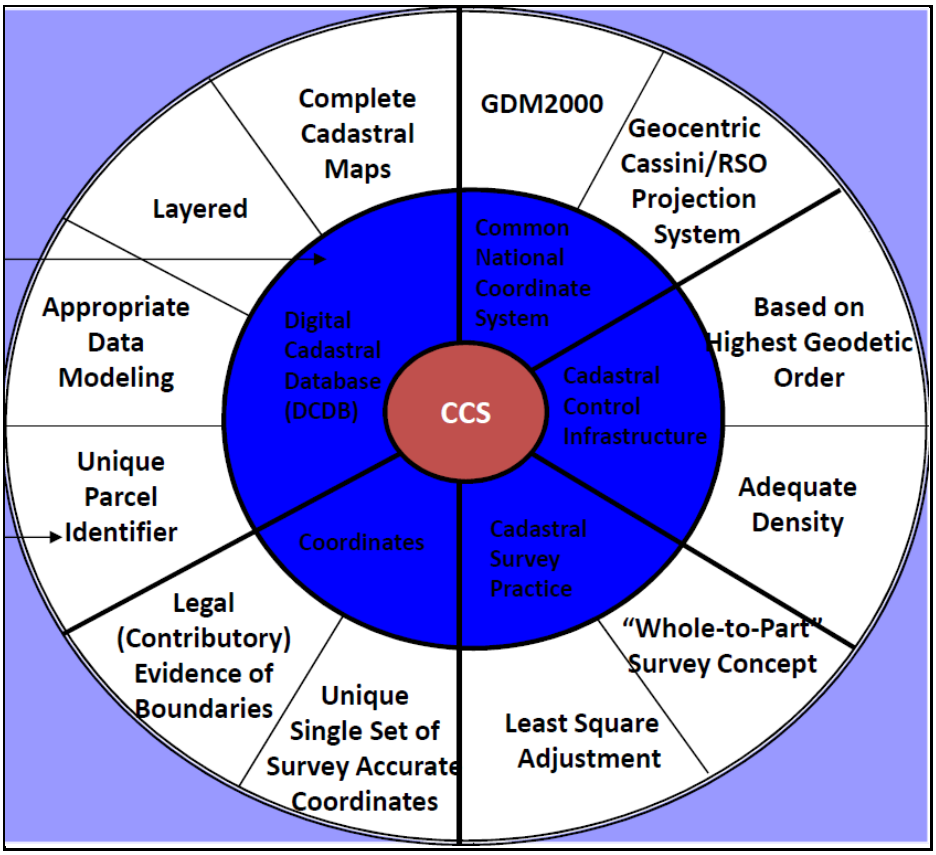


Figure 2.6 Component of CCS

The DSMM determines to introduce a nation-wide cadastral field reform by implementing CCS project (Kadir, Ses, Desa, Tong, & Boo, 2000). It is proposed to replace the current Cassini coordinate system which has been used for years in cadastre with RSO coordinate system. Cassini system based on multiple State origins is considered no longer appropriate for potential CCS needs where it is desirable to have a homogeneous coordinate system. This study has conducted to overcome reliability of the cadastral coordinate values of the boundary marks in this area. This problem could be due to the errors propagation effects resulted from the Bowditch adjustments being practiced before establishment of e-Cadastre. GPS observations were carried out by the DSMM to provide an sufficient numbers of control points within the study area. LSA was carried out once the data entry process for the individual sub-block completed.

The CCS have been discussed on (Teoh, 2009) paper about construction and development of a Malaysian Geographic Information System (GIS) database repository for location data sources accessible in Malaysia. This paper addressed problems with the use of different data in surveys and cadasters, not only caused inconveniences such as the migration from RSO to Cassini, but also created questions about data incompatibility with existing satellite navigation systems. Writer proposed Location based System (LBS) that allows a user to search, identify and check for location information. In order to improve the conversion of coordinate transformation has address by writer, it is better to precompute and build lookup tables for faster results.

2.5.2 National Digital Cadastre Database (NDCDB)

The National Digital Cadastral Survey Database (NDCDB) is a new digital platform for land surveying database replacing the Digital Cadastral Survey Database (DCDB). The information shown in the database such as Unique Parcel Identifier (UPI), lot number, area and lot boundary information. The format is in vector graphics format for example *.shp, *.tab, *.dxf, *.dgn and others.

Several studies have been conducted to study the NDCDB. One study that have been conducted is the handling of NDCDB with GIS application by (Abdul Halim, Sulaiman, Talib, & Majeed, 2018). The technique used was a case study duplicated to five establishment of GIS applications from different agencies such as eKadasOnline, SKiP, iPlan, TM SmartMap and DBKL Interactive Portal. Some suggestions that highlighted in this paper to rectify knowledge-based mistakes found in this study, that included the ensuring the NDCDB's cut-off-date, utilizes all existing NDCDB layers, ensure to use the map projection parameters are the authorized and official value. Based on the data from the multi-case report, the rival propositions were considered to be more appropriate for summarizing the overall results,

which were certain methods of applying NDCDB for land-based spatial analysis as certain users had a partial understanding of the NDCDB properties.

Another study that have been conducted to NDCDB on GIS application is identifying the relevant features of the (NDCDB) for spatial analysis by using the Delphi Technique by (N. Z.A. Halim, Sulaiman, Talib, & Ng, 2018). In this paper the Delphi methodology approach is considerably explored. This research has achieved its objective of defining statements that better explain the related features of NDCDB for spatial analysis by optimizing the Delphi methodology based on the consensus of experts on ground, cadastral and GIS domain. Agreement and stability of the consensus on the statements were achieved.

This Delphi techniques method also apply on (Nur Zurairah Abdul Halim et al., 2017) paper about the Legal significance of National Digital Cadastral Database (NDCDB) in Malaysia Cadastral System. To determine the legal significance of NDCDB and evaluate its key themes, insights, and judgements on a collective basis from diverse expertise seemed suitable. This work has provided clarity about the implementation of NDCDB, at least where the issue is legal comparison. From the analysis it can be summarized that NDCDB does not have a clear legal relation for boundary description but as an option for boundary comparisons to a particular spatial tolerance and is also one of the many approved cadastral databases used in DSMM.

2.6 Online Observation

On-line method is a situation where a boundary marks are parallel towards other boundary marks. This method can used when to planted a new boundary marks as stated in Pekeliling Ketua Pengarah Ukur Dan Pemetaan Circular Bil. 3 Tahun 2003

until boundary marks is proven in right position. This usually happen at terrace housing area. Figure 1.2 shows that on-line method that usually implement.

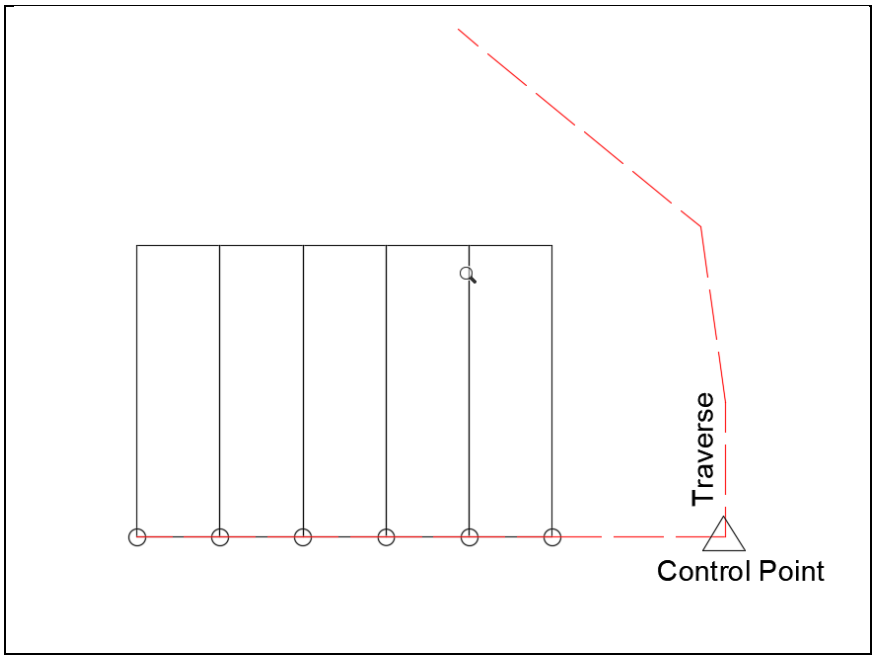


Figure 2.7 Example of online observation

2.7 Issues of method observation during on-line observation in Least Square Adjustment

2.7.1 Intersection

The issues have been highlighted for the intersection method observation are in LSA are its necessity when performing on-line observation. Intersection method are done to ensure position of station when the distances of objects are large or cannot be measured properly. This due to all EDM observations are subject to instrumental errors that manufacturers list as constant and scalar (Ghilani & Wolf, 2006). The circular is not stated the necessity of intersection method for any of field work but as for on-line method, intersection method is require for this job as the concern of this

study to prove the requirement for this method when performing on-line method.

2.7.2 Resection

The issues of resection exactly have the same issues as subsection 2.7.1. Both of resection and intersection are necessary when performing on-line method during surveying works to ensure the placement of boundary marks are placed in right position as to ensure the accuracy of survey works. These two methods are proposed when performing on-line is due to ensure the reliability value of coordinates of boundary marks.

2.7.3 Radiate

Radiate is common method using when performing on-line method. The radiate method usually performed especially when to place the boundary marks. The issues of radiate itself doubting its reliability of this method during survey works. This is due to the radiate does not have geometrically checking as resection and intersection method. After an adjustment have been made using least square, the value of bearing and distance have been differed from the original one. The maximum distance when performing radiate are 300 meters. What are the effects towards value of bearing, distance and coordinate when performing radiate in on-line method based on short and long distance? These are the main issues of radiate in on-line method if least square are be used for the adjustment.

2.8 Conclusion

The important aspects of the existing this literature review is to identify the work contribution for better understanding the research problem being studied. Based on research in this literature review, any of method have been describe the relationship of each method studied to the others consideration. This is important to locate this

research within the context of existing literature and to prevent the duplication of effort.

The method used in this study have been reviewed and the gaps in existing studied have been identified for better improvement in this research. For future study, the suggested method should be implement in this research which is radiate method in on-line method in Least Square Adjustment.

The findings of this literature review have shown that the gaps in on-line method procedure where there is no geometry data checking when performing radiate method. Others study found that there are disadvantages of least square adjustment in other method such as GNSS and may affect the NDCDB which the main hub of geospatial data.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

This chapter will emphasis the methodology and flowchart in order to achieve the aim and objectives of this research works, there are several of data processing had been done. The methodology of this project is divided into five (5) main phases such as i) planning, ii) data acquisition, iii) data processing, iv) result and analysis and v) conclusion.

3.2 Preliminary Studies

The first thing that needs to be done during Step 1 is to develop the concept for the project title. Until identifying the required criteria, it is necessary to identify aim and objectives while simplifying the name. In the literature review, these parameters needed to be brief in detail so that the information and idea can be added smartly and the understanding of the project can be firmly established. This study is focusing on the impact on radiation and on-line method in cadastral observation method and its suitability in least square adjustment. The procedure, software and parameter required to execute this research were also determined. This phase ended with the execution of data processing by using Micro STARNet software to achieve the aim and objectives of study.

3.2.1 Data acquisition

The data for this research used a secondary data which is simulation data. The data was designated using CAD software which is AutoCAD version 2016. The traverse data was designated on CAD software replacing the real job since there are limitation for acquiring data on site. A closed traverse was drawn on AutoCAD while following the standard tolerance according to JUPEM's circular. The data that have been used for this research is bearing, distance, area and coordinate.

3.2.2 Software used

The software used to complete this study are AutoCAD version 2016, MicroSurvey STARNet software, Microsoft Excel and IBM SPSS Statistic software.

i. CAD software

AutoCAD is a software framework for engineering computer-aided design (CAD) and drafting. AutoCAD 2016 was used for designing the simulation data which are traverse and method of acquire the housing's boundary marks which radiate and intersection method. Figure 3.1 shows that AutoCAD 2016 used in this research.

Figure 3.1 CAD software used for this research

ii. Microsoft Excel

Microsoft Excel used in this research when all form data need to be extract from the AutoCAD software. The data extraction function from AutoCAD can be extract into of (.xlsv) format. The Microsoft Excel itself was used to calculate the value of bearing from degree minute second format (00°00′00") to radian. Micosoft Excel also used to classify all of the bearing, distance, area and coordinate of each boundary marks.

iii. MicroSurvey's STAR*NET

MicroSurvey's STAR*NET is the least square adjustment software recognized in the world. STAR*NET has earned a reputation as a manufacturer of least square correction solutions for being easy to use, highly accurate and reliable. The results of STAR*NET serve as the industry benchmark and are prescribed as the mandatory package of adjustments in some jurisdictions when used in the submission of plans. Figure 3.2 shows that software was used in this study.

Figure 3.2 Software used

iv. IBM SPSS Statistic

SPSS Statistics is a leading statistical app, is equipped for ad hoc modeling, hypothesis testing, geospatial modeling and predictive analytics to solve market and science problems. IBM SPSS Statistic was used to calculate statistical value mean, minimum, maximum, range, and standard deviation of residual bearing, residual distance, residual area and residual coordinate.

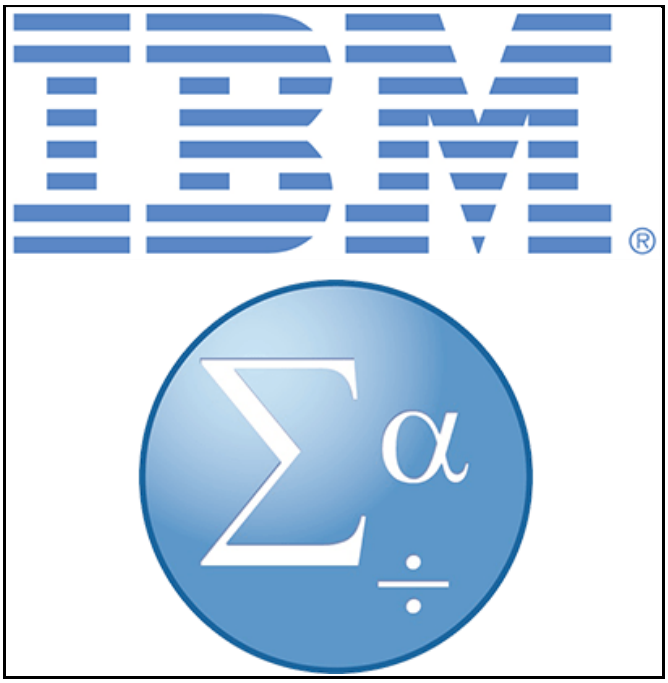


Figure 3.3 IBM SPSS Statistic

3.3 Flowchart of methodology

In order to achieve the aim and objectives of this research works, there are several of data processing had been done. Figure illustrates the general methodology of this research. The methodology of this project is divided into five (5) main phases such as i) planning, ii) data acquisition, iii) data processing, iv) result and analysis and v) conclusion.

The methodology of this study consists of five phases as shown in Figure 1. The four five phases are planning, data acquisition, data processing, result and analysis, and conclusion. The first phase is focusing on the issues and problem of the study. In this phase, the method, type of data and in order to perform data acquisition is identified and listed out.

The second phase is known as data simulation. In order to achieve the objectives of this study, horizontal control established and to achieve the first objectives which is using radiation based on single leg method. A several different distances have been using to find out the impact on radiation method based on single leg. The

second objective is to study the impact of geometry data checking using double independent check (DIC) and intersection method. The same distance as in first method were used to test this geometry data checking method which are 50m, 100m, 150m, 200m, 250m and 300m.

These data will undergo data processing phase using LSA software. Next, result and analysis process. In this process, the data is process based on aim and the objectives of the study. By the end of this phase, a new suggestion will be made which are to propose the new method of procedure of on-line and radiation method.

Last but not least, the conclusion phase. From the analysis made, this can study can be concluded to be achieve its aim or not. Figure 3.4 shows that flowchart of research methodology involves in this study.

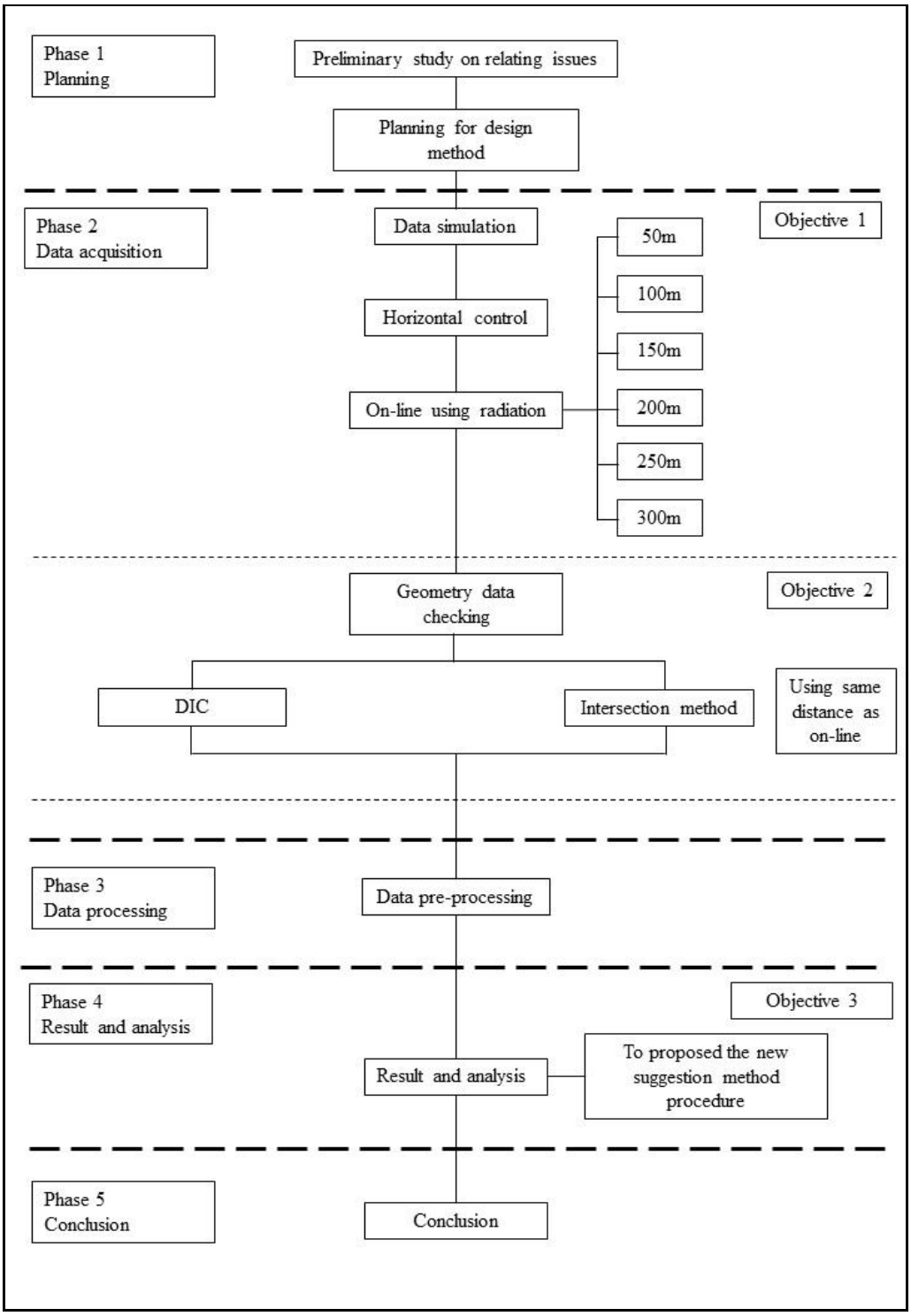


Figure 3.4 Flowchart methodology

3.4 Design of simulation data

A closed traverse was designated using CAD software following the JUPEM's circular based on its tolerance. Both of face right and face left should be not more than $00°00'20"$ and distance not more than 0.01m. There are about 22 horizontal control points established using AutoCAD software. Figure 3.5 shows that a closed traverse design on AutoCAD 2016 software.

Then, seven housing lot with standard dimension $23\,ft \times 70\,ft$ or $7.315m \times 21.336m$ was designated in the middle of the traverse so that the next step for research can be conducted. The next procedure was performed a radiate method from control points to housing lot boundary marks with distance 50m, 100m, 150m, 200m, 250m and 300m. Appendix A until Appendix F is the input file (.txt) for every distance mentioned.

Station 3 was radiate with average 50m, station 5 radiated with 100m, station 9 radiated with 150m, station 13 radiated with 200m, station 16 radiated with distance 250m and lastly station 20 was radiated with the maximum distance 300m. All of input file for these distances are given on Appendix. Figure 3.6 shows illustrator of what surveyor normally do when emplacing the boundary marks for terrace housing lot. Figure 3.6 shows that radiation method was used to for simulation data. Appendix G is input file DIC geometry data checking and Appendix I is for intersection method input file (.txt).

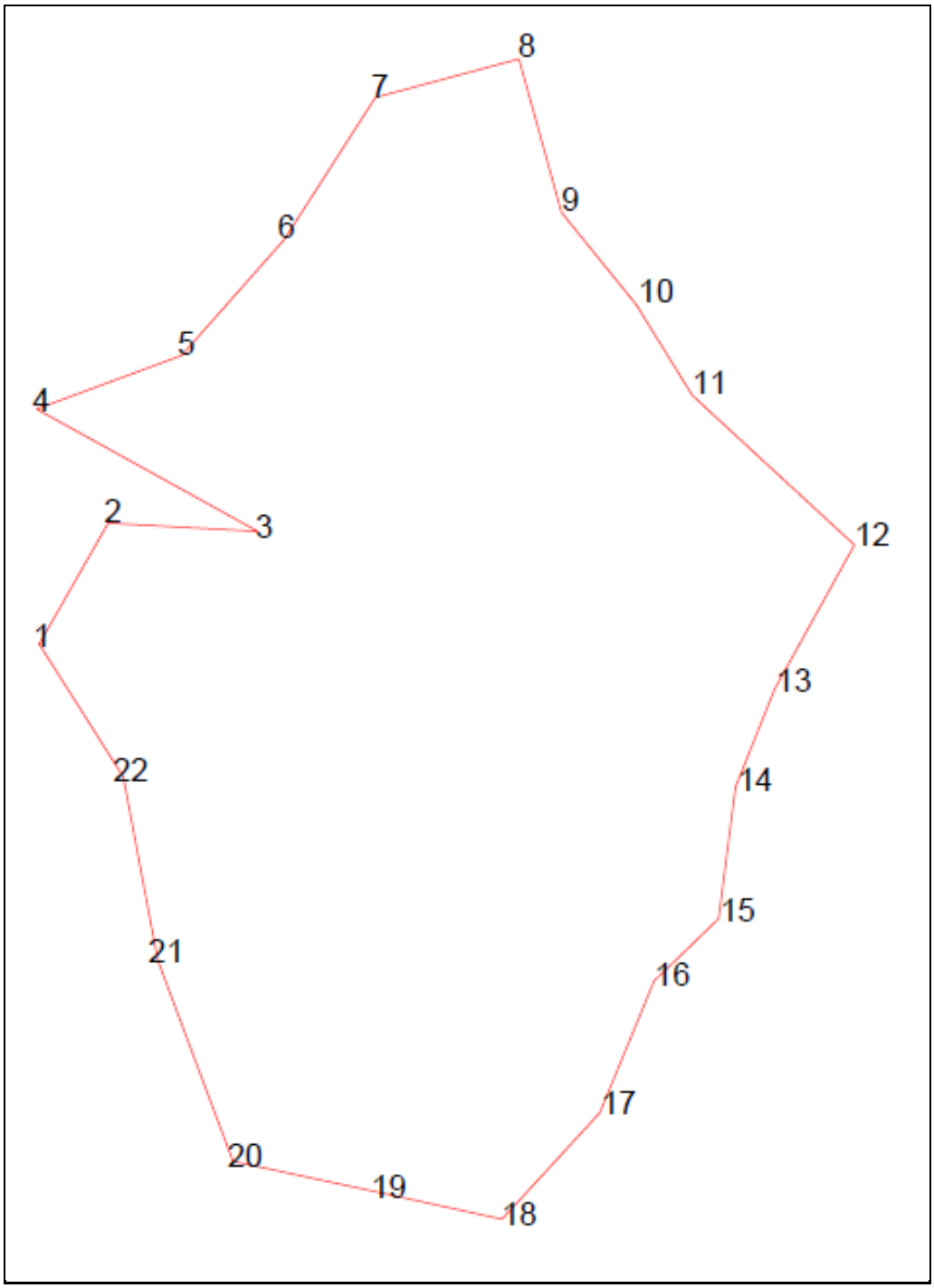


Figure 3.5 A closed traverse

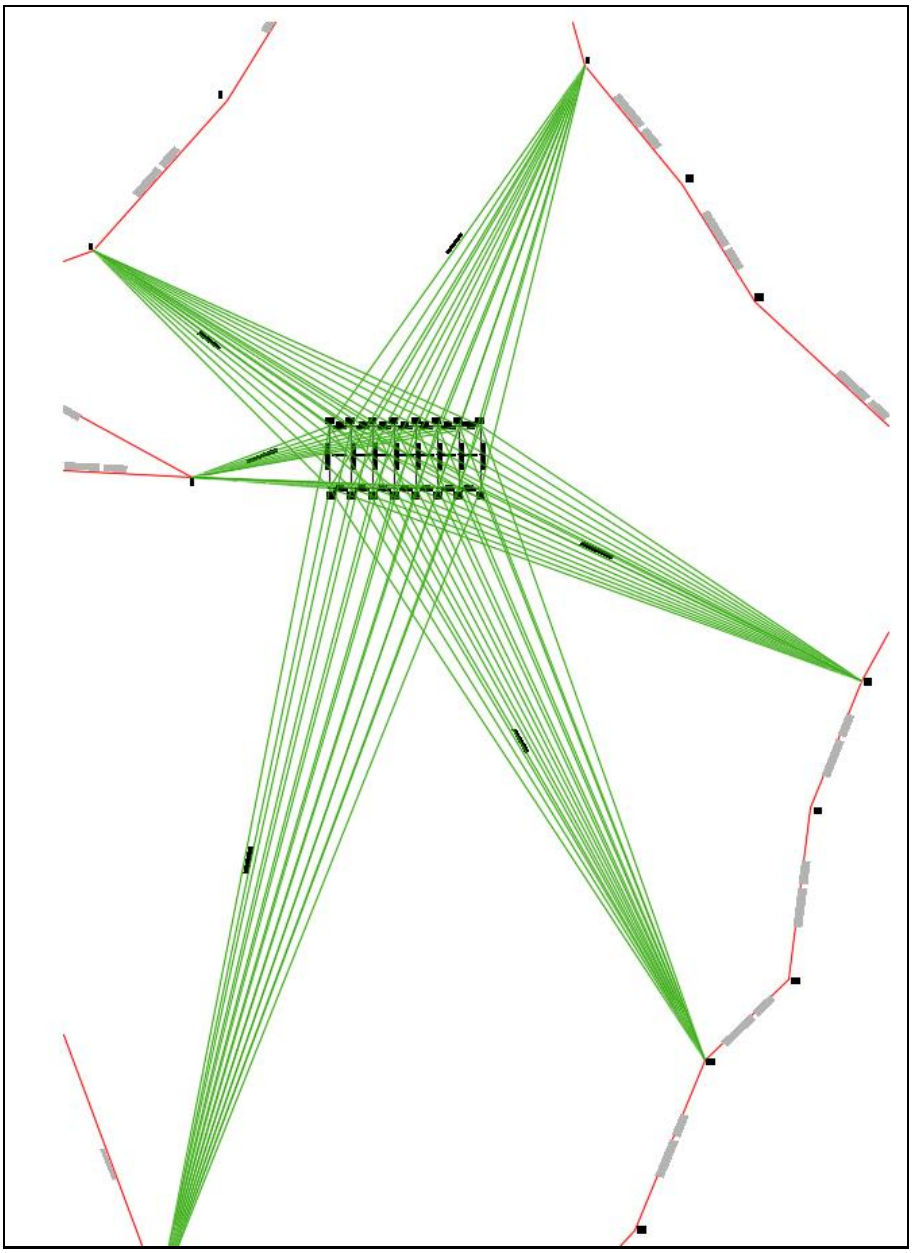


Figure 3.6 Radiate method with six (6) different distance on AutoCAD

The next procedure is one of the stations which is station 3 has been moves to apply the geometry data checking procedure using double independence check (DIC) and intersection method. The DIC has been done on station 3 while intersection has been done at station 3 and station 4. Figure 3.7 shows that when station has been moved (3'), the setting out work still proceed using the true bearing without realized the

station 3 has been moved. In order to check whether the station have been moved or not, the surveyor apply the DIC and intersection method.

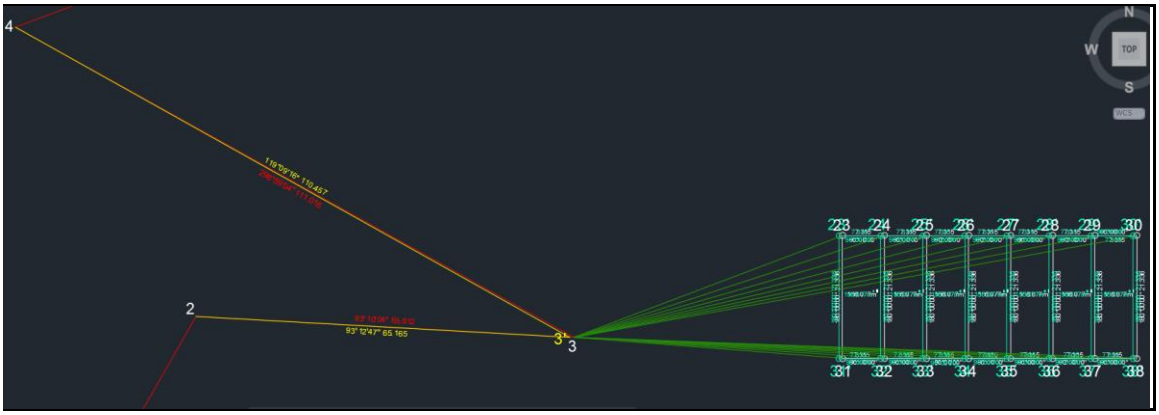


Figure 3.7 Lot has been moved from the actual position

3.5 Data Processing

Data processing is a method of evaluating information either analytical and statistical tools to search for helpful data for produce a method of procedure as an conclusion. This tools enables to explore for information, notice patterns in it and answer any question on it. For this study, a simulation data was used and all of data was processed using accurate statistical method.

3.5.1 Least Square Adjustment

As for JUPEM have go from Bowditch to LSA, an adjustment has been made using STAR*Net software. Six input files have been created as using (.txt) where all the data such as bearing, distance and coordinate from traverse and radiate have been inserted. Figure 3.7 shows that example of input file using (.txt) of traverse and radiate with distance 50m. The rest of input file as stated in Appendix section. Then, the input file has been imported to STAR*Net software to run adjustment. Figure 3.8 shows that processing of

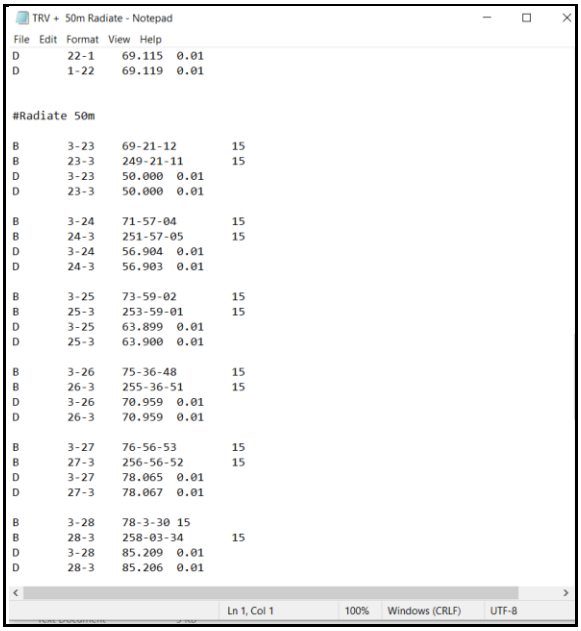


Figure 3.8 Examples of input file of traverse and radiate with distance 50m

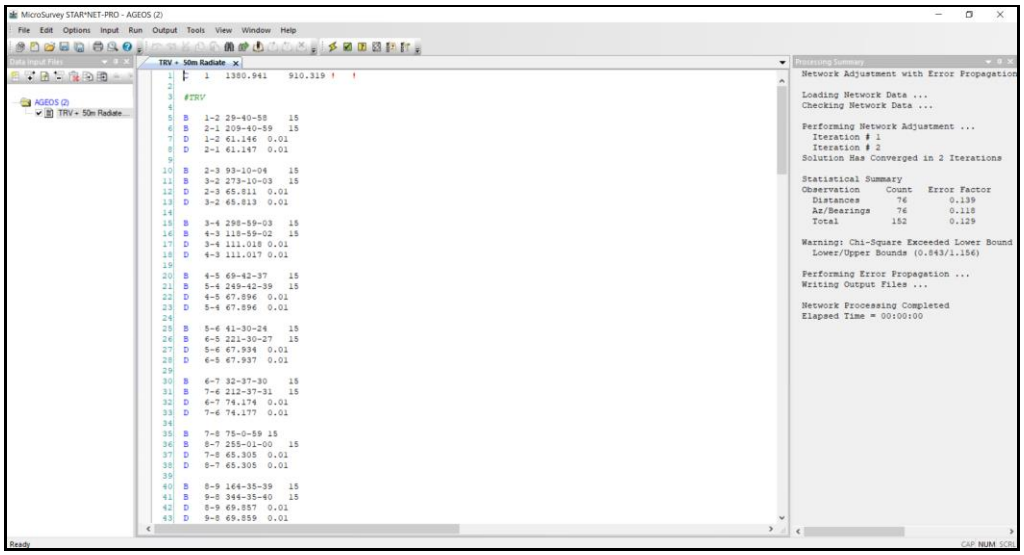


Figure 3.9 STAR*Net processing

3.5.2 Calculation of residual value

The residual of bearing, distance and area have been made using the formula:

$$Residual = Value\ before\ adjustment - value\ after\ adjustment$$

All of residual has calculate using Microsoft Excel.

3.5.3 IBM SPSS Statistic

After all of residual value have been calculated using Microsoft Excel, the IBM SPSS Statistic was used to calculate the value of mean, minimum, maximum, range and standard deviation of residual for six radiate distances.

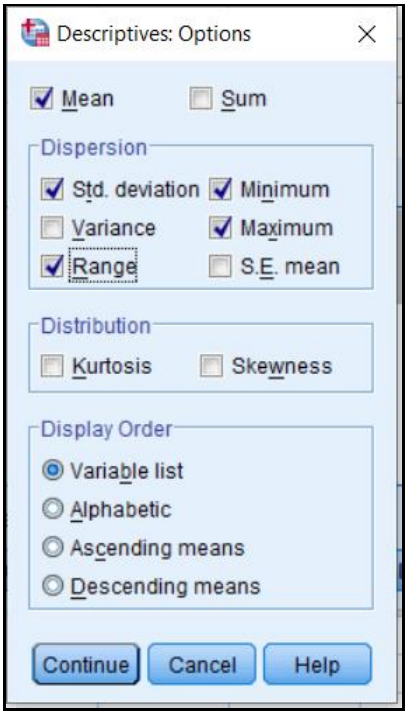


Figure 3.10 IBM SPSS Statistic procedure

3.6 Result and Analysis

Once the data have fully processed using Star*NET software, the results from Star*NET software next will go for the statistical test analysis using the IBM SPSS Statistic software. The result and analysis showed that the impact of single leg observation radiate with short and long distance from control points. In this section showed the different of residual bearing, distance, area and coordinate of methods used for this research.

3.7 Summary

This chapter reviews method used for data design simulation, data processing analysis and result and analysis. In the first phase explained about problems occur in this research and planning of designing simulation data to demonstrate the

problem as stated in problem statement. Then, the second phase discusses about the method used in data simulation. Third phase explained about data processing using Star*NET and IBM SPSS Statistic software. This software used to enhance the realiability . Last result from the study.

CHAPTER FOUR
RESULT AND ANALYSIS

4.1 Introduction

4.2 Result

4.2.1 Residual bearing, distance and area of radiate method

Table 4.1 until Table 4.6 shows that result of residual after been computed using IBM SPSS Statistic software. Figure 4.1 shows that true value of lot before adjustment and Figure 4.2 until Figure 4.7 shows that value of lot with bearing, distance and area that have been radiate with distance 50m, 100m, 150m, 200m, 250m and 300m.

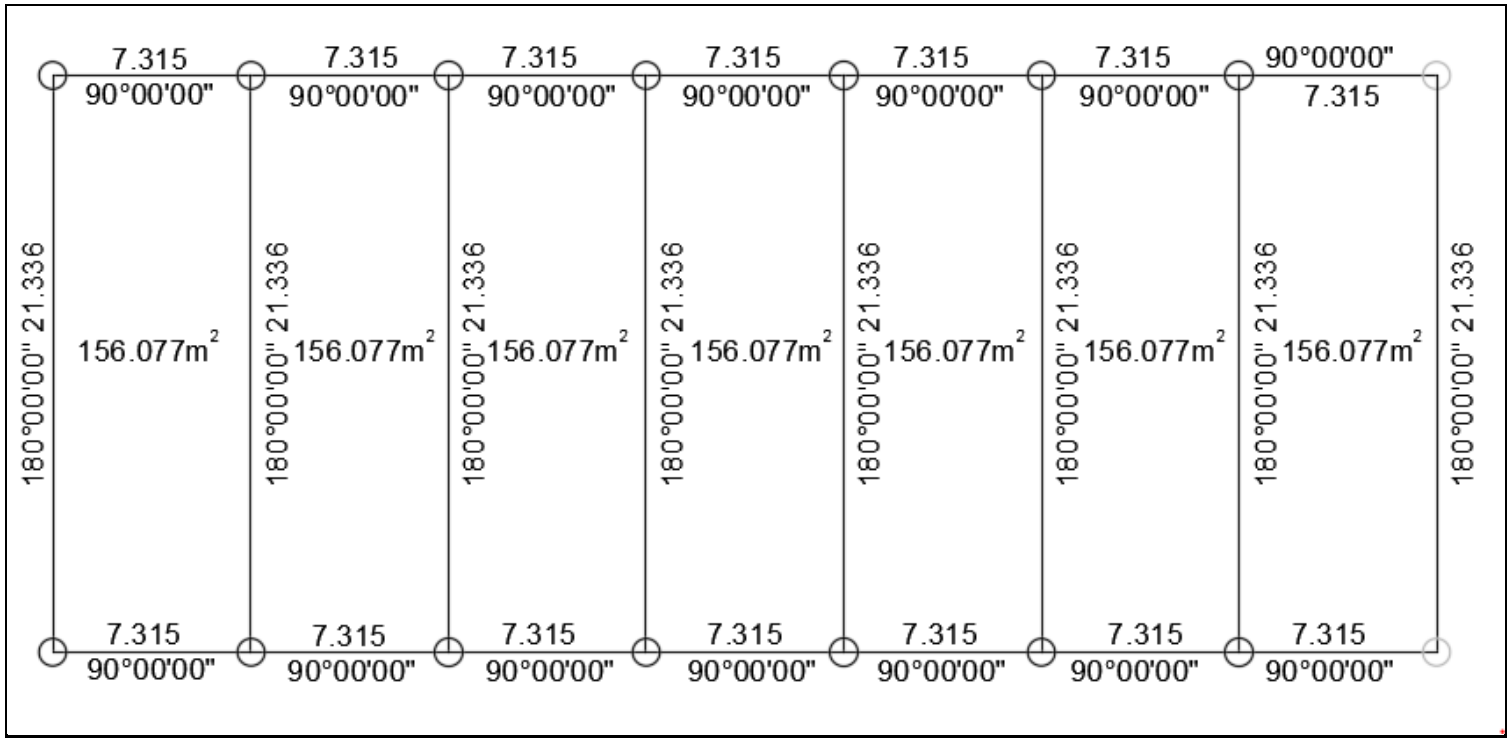


Figure 4.1 The true value of terrace lot

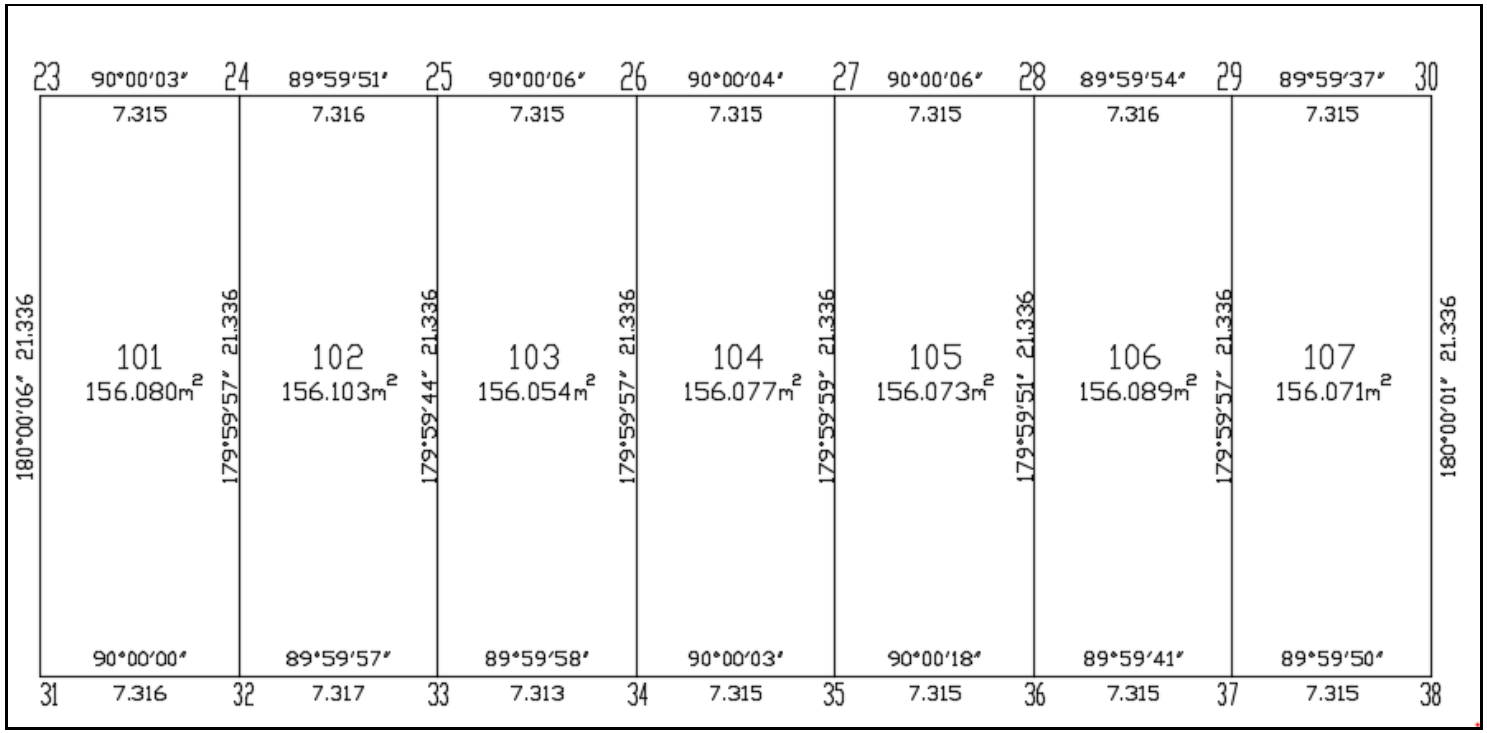


Figure 4.2 Value of bearing, distance, and area of 50m after an adjustment

Table 4.1 The results of residual bearing, distance, and area radiate with 50 meters

Lot	Line	Residual bearing (DMS)	Residual distance (m)	Residual area (m^2)
	23-24	-00-00-03	0.000	
101	31-32	00-00-00	-0.001	-0.003
	23-31	-00-00-06	0.000	
	24-32	00-00-03	0.000	
	24-25	00-00-09	-0.001	
102	32-33	00-00-03	-0.002	-0.026
	25-33	00-00-16	0.000	
	25-26	-00-00-06	0.000	
103	33-34	00-00-02	0.002	0.023
	26-34	00-00-03	0.000	
	26-27	-00-00-04	0.000	
104	34-35	00-00-0	0.000	0.000
	27-35	00-00-01	0.000	
	27-28	-00-00-06	0.000	
105	35-36	-00-00-18	0.000	-0.012
	28-36	00-00-09	0.000	
	28-29	00-00-06	-0.001	
106	26-37	00-00-19	0.000	-0.012
	29-37	00-00-03	0.000	
	29-30	00-00-23	0.000	
107	37-38	00-00-10	0.000	0.006
	30-38	-00-00-10	0.000	
Mean		00-00-03	0.000	-0.001
Minimum		-00-00-18	-0.002	-0.026
Maximum		00-00-23	0.002	0.023
Range		00-00-41	0.004	0.049
Standard deviation		00-00-09	0.001	0.015

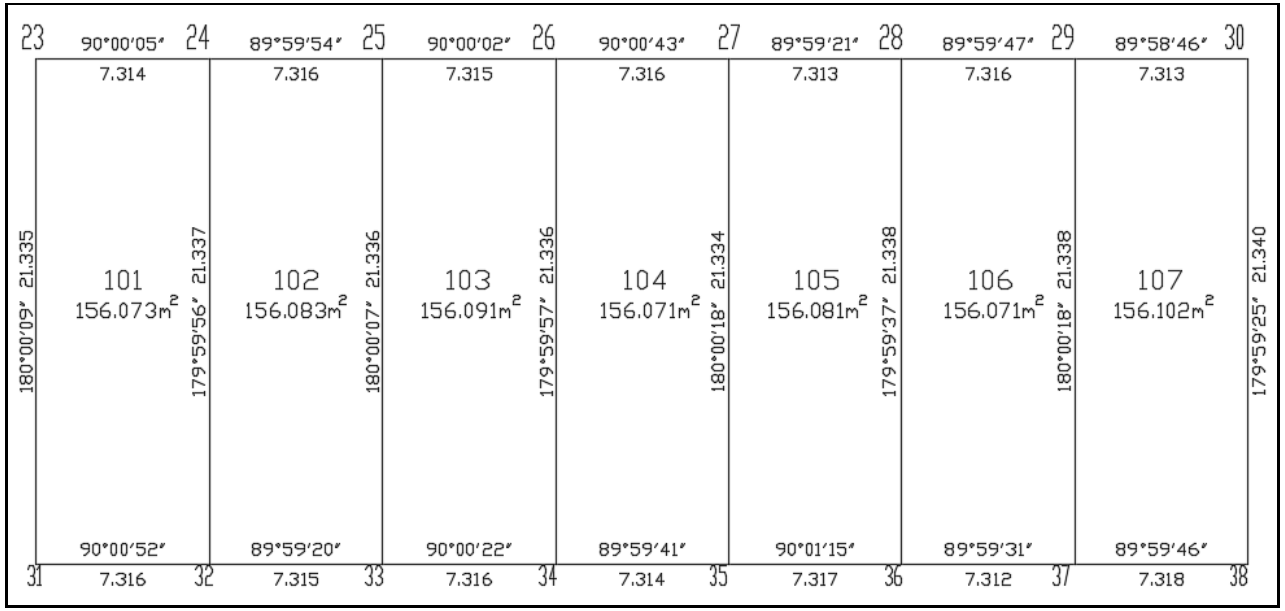


Figure 4.3 Value of bearing, distance, and area of 100m after an adjustment

Table 4.2 The results of residual bearing, distance, and area radiate with 100 meters

Lot	Line	Residual bearing (DMS)	Residual distance (m)	Residual area (m^2)
	23-24	-00-00-05	0.001	
101	31-32	-00-00-52	-0.001	0.004
	23-31	-00-00-09	0.001	
	24-32	00-00-04	-0.001	
	24-25	00-00-40	0.000	
102	32-33	00-00-06	-0.001	-0.006
	25-33	-00-00-07	0.000	
	25-26	-00-00-02	0.000	
103	33-34	-00-00-22	-0.001	-0.014
	26-34	00-00-03	0.000	
	26-27	-00-00-43	-0.001	
104	34-35	00-00-19	0.001	0.006
	27-35	-00-00-18	0.002	
105	27-28	00-00-39	0.002	
	35-36	-00-01-15	-0.002	-0.004
	28-36	00-00-23	-0.002	
	28-29	00-00-13	-0.001	
106	26-37	00-00-29	0.003	0.006
	29-37	-00-00-18	-0.002	
	29-30	00-01-14	0.002	
107	37-38	00-00-14	-0.003	-0.025
	30-38	00-00-35	-0.004	
Mean		00-00-02	0.000	-0.005
Minimum		-00-01-05	-0.004	-0.025
Maximum		00-01-14	0.003	0.006
Range		00-02-29	0.007	0.031
Standard deviation		00-00-33	0.002	0.012

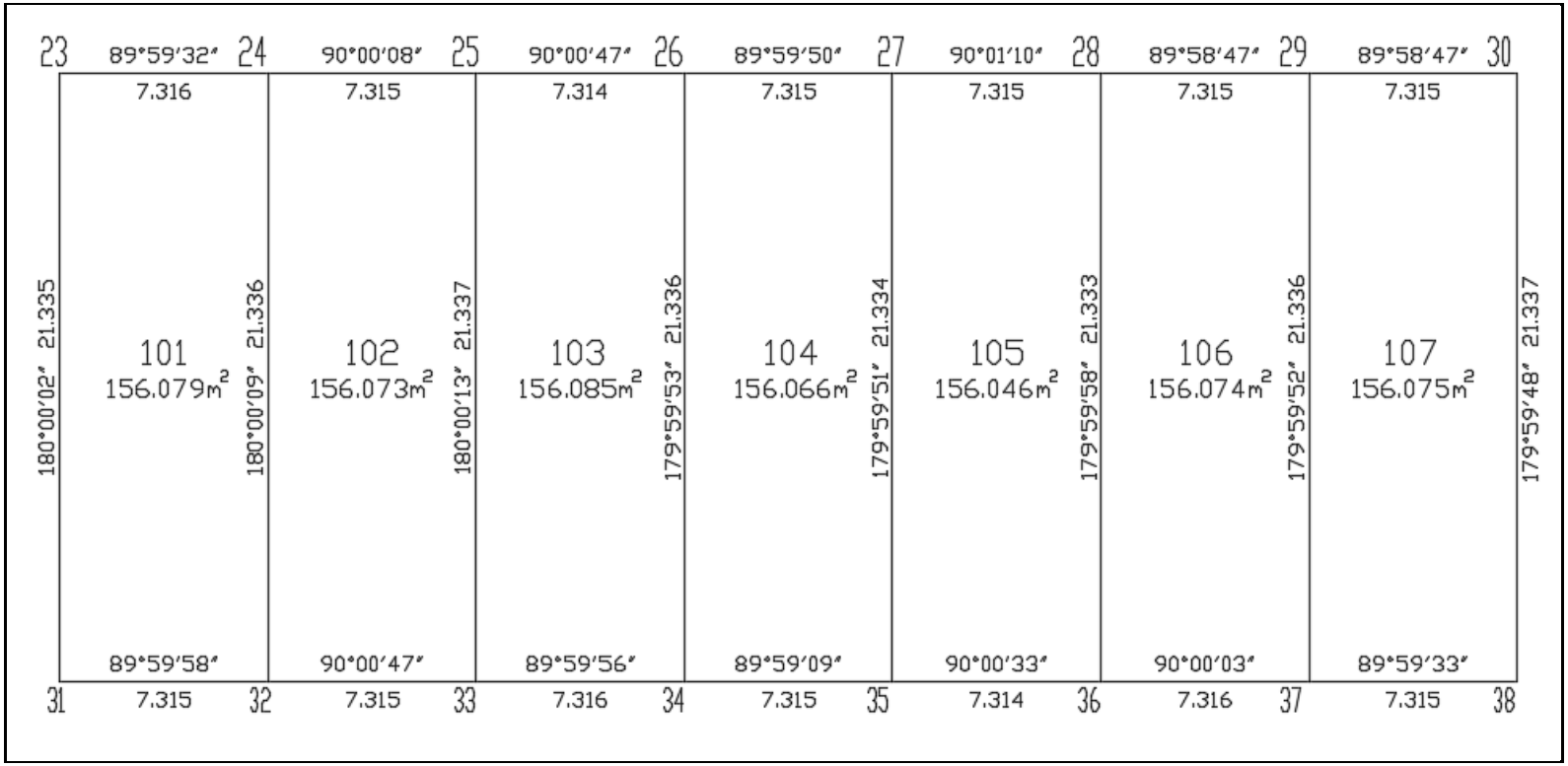


Figure 4.4 Value of bearing, distance, and area of 150m after an adjustment

Table 4.3 The results of residual bearing, distance, and area radiate with 150 meters

Lot	Line	Residual bearing (DMS)	Residual distance (m)	Residual area (m^2)
	23-24	00-00-28	-0.001	
101	31-32	00-00-02	0.000	-0.002
	23-31	-00-00-02	0.001	
	24-32	-00-00-09	0.000	
102	24-25	-00-01-20	0.000	
	32-33	-00-00-47	0.001	0.004
	25-33	-00-00-13	-0.001	
103	25-26	-00-00-47	0.000	
	33-34	00-00-04	-0.001	-0.008
	26-34	00-00-07	0.000	
104	26-27	00-00-10	0.00	
	34-35	00-00-51	0.000	0.011
	27-35	00-00-09	0.002	
105	27-28	-00-01-10	0.000	
	35-36	-00-00-33	0.001	0.031
	28-36	00-00-02	0.003	
106	28-29	00-01-13	0.000	
	26-37	-00-00-03	-0.001	0.003
	29-37	00-00-08	0.000	
107	29-30	00-01-13	0.000	
	37-38	00-00-27	0.000	0.002
	30-38	00-00-12	-0.001	
Mean		00-00-03	0.000	0.006
Minimum		-00-01-10	-0.001	-0.008
Maximum		00-01-13	0.003	0.031
Range		00-02-23	0.004	0.039
Standard deviation		00-00-35	0.001	0.013

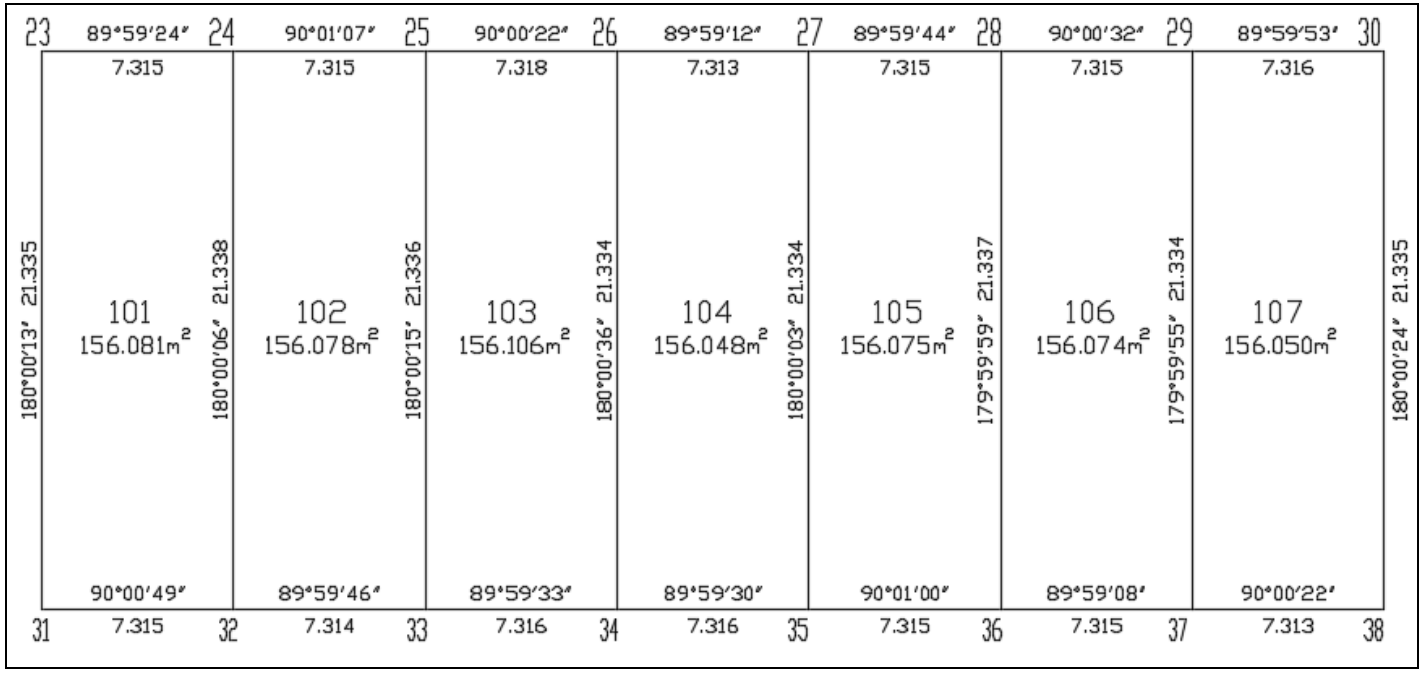


Figure 4.5 Value of bearing, distance, and area of 200m after an adjustment

Table 4.4 The results of residual bearing, distance, and area radiate with 200 meters

Lot	Line	Residual bearing (DMS)	Residual distance (m)	Residual area (m^2)
	23-24	00-00-36	0.000	
101	31-32	-00-00-49	0.000	-0.004
	23-31	-00-00-13	0.001	
	24-32	-00-00-06	-0.002	
102	24-25	-00-01-07	0.000	
	32-33	00-00-14	0.001	-0.001
	25-33	-00-00-15	0.000	
103	25-26	-00-00-22	-0.003	
	33-34	00-00-27	-0.001	-0.029
	26-34	-00-00-36	0.002	
104	26-27	00-00-48	0.002	
	34-35	00-00-30	-0.001	0.029
	27-35	-00-00-30	0.002	
105	27-28	00-00-16	0.000	
	35-36	00-00-06	0.000	0.002
	28-36	00-00-01	-0.001	
106	28-29	-00-00-32	0.000	
	26-37	00-00-52	0.000	0.003
	29-37	00-00-05	0.002	
107	29-30	00-00-07	-0.001	
	37-38	-00-00-22	0.002	0.027
	30-38	-00-00-24	0.001	
Mean		00-00-50	0.000	0.004
Minimum		-00-01-07	-0.003	-0.029
Maximum		00-00-52	0.002	0.029
Range		00-01-59	0.005	0.058
Standard deviation		00-00-33	0.001	0.020

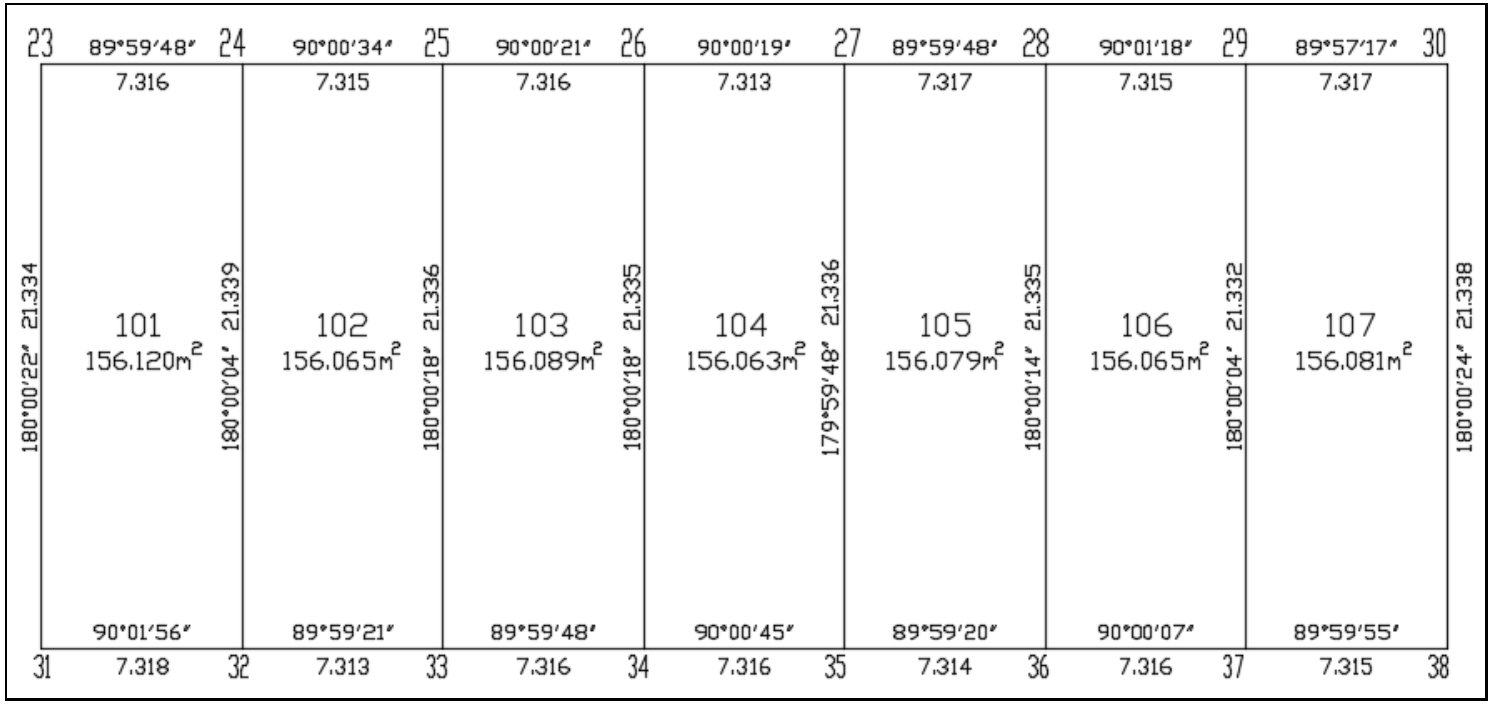


Figure 4.6 Value of bearing, distance, and area of 250m after an adjustment

Table 4.5 The results of residual bearing, distance, and area radiate with 250 meters

Lot	Line	Residual bearing (DMS)	Residual distance (m)	Residual area (m^2)
	23-24	00-00-12	-0.001	
101	31-32	-00-01-56	-0.003	-0.043
	23-31	-00-00-22	0.002	
	24-32	-00-00-04	-0.003	
	24-25	-00-00-34	0.000	
102	32-33	00-00-39	0.002	0.012
	25-33	-00-00-18	0.000	
	25-26	-00-00-21	-0.001	
103	33-34	00-00-12	-0.001	-0.012
	26-34	-00-00-1	0.001	
	26-27	-00-00-19	0.002	
104	34-35	-00-00-45	-0.001	0.014
	27-35	00-00-12	0.000	
	27-28	00-00-12	-0.002	
105	35-36	00-00-40	0.001	-0.002
	28-36	-00-00-14	0.001	
	28-29	-00-01-18	0.000	
106	26-37	-00-00-07	-0.001	0.012
	29-37	-00-00-04	0.004	
	29-30	00-02-41	-0.002	
107	37-38	00-00-05	0.000	-0.004
	30-38	-00-00-24	0.000	
Mean		-00-00-06	0.000	-0.003
Minimum		-00-01-56	-0.003	-0.043
Maximum		00-02-41	0.004	0.014
Range		00-04-37	0.007	0.057
Standard deviation		00-00-51	0.002	0.020

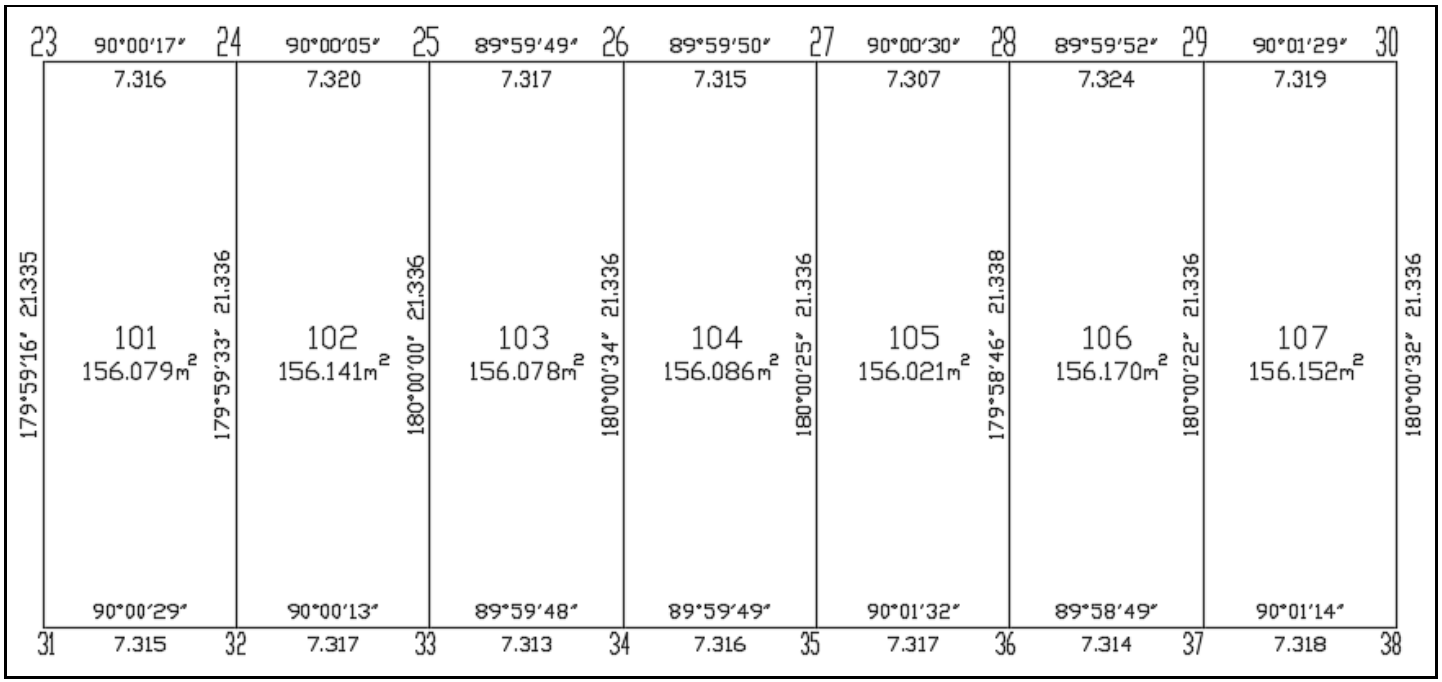


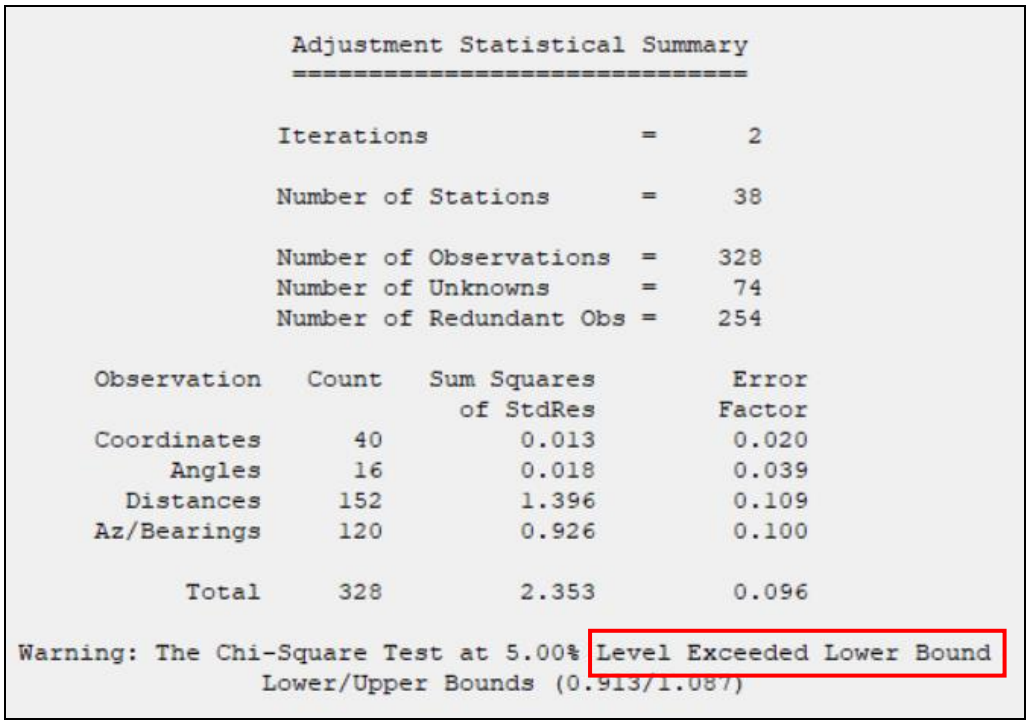
Figure 4.7 Value of bearing, distance, and area of 250m after an adjustment

Table 4.6 The results of residual bearing, distance, and area radiate with 300 meters

Lot	Line	Residual bearing (DMS)	Residual distance (m)	Residual area (m^2)
	23-24	-00-00-17	-0.001	
101	31-32	-00-00-29	0.000	-0.002
	23-31	00-00-44	0.001	
	24-32	00-00-27	0.000	
	24-25	-00-00-05	-0.005	
102	32-33	-00-00-13	-0.002	-0.064
	25-33	00-00-00	0.000	
	25-26	00-00-11	-0.002	
103	33-34	00-00-12	0.002	-0.001
	26-34	-00-00-34	0.000	
	26-27	00-00-10	0.000	
104	34-35	00-00-11	-0.001	-0.009
	27-35	-00-00-25	0.000	
	27-28	-00-00-30	0.008	
105	35-36	-00-01-32	-0.002	0.056
	28-36	00-01-14	-0.002	
	28-29	00-00-08	-0.009	
106	26-37	00-01-11	0.001	-0.093
	29-37	-00-00-22	0.000	
	29-30	-00-01-29	-0.004	
107	37-38	-00-01-14	-0.003	-0.075
	30-38	-00-00-32	0.000	
Mean		-00-00-09	-0.01	-0.027
Minimum		-00-01-32	-0.009	-0.093
Maximum		00-01-14	0.008	0.056
Range		00-02-46	0.017	0.149
Standard deviation		00-00-43	0.003	0.053

4.2.2 Double Independence Check (DIC)

Figure 4.1 shows that Chi Square Test of double independence check at station 3 without move the station 3 while Figure 4.2 shows that Chi Square Test of double independence check at station 3 when station 3 has been moved.



Adjustment Statistical Summary

Iterations = 2

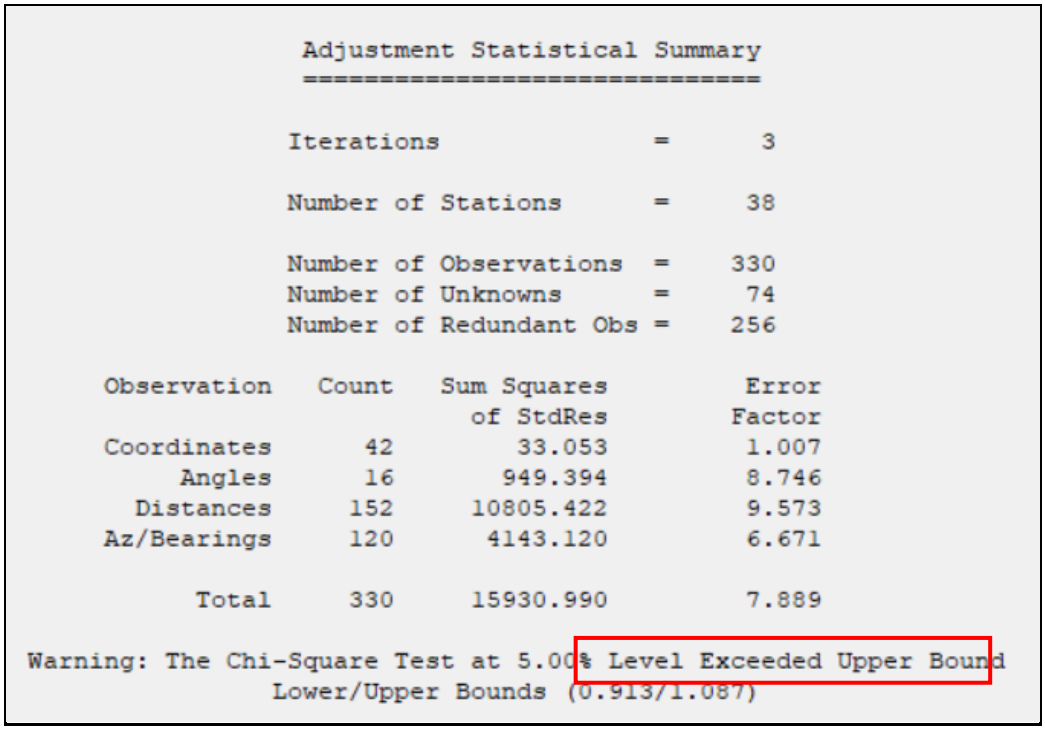
Number of Stations = 38

Number of Observations = 328
Number of Unknowns = 74
Number of Redundant Obs = 254

Observation	Count	Sum Squares of StdRes	Error Factor
Coordinates	40	0.013	0.020
Angles	16	0.018	0.039
Distances	152	1.396	0.109
Az/Bearings	120	0.926	0.100
Total	328	2.353	0.096

Warning: The Chi-Square Test at 5.00% Level Exceeded Lower Bound
Lower/Upper Bounds (0.913/1.087)

Figure 4.8 Chi Square Test of true value when checking with DIC



```
                Adjustment Statistical Summary
                ==============================

               Iterations              =      3

               Number of Stations      =     38

               Number of Observations  =    330
               Number of Unknowns      =     74
               Number of Redundant Obs =    256

    Observation    Count    Sum Squares          Error
                              of StdRes         Factor
    Coordinates       42        33.053          1.007
         Angles       16       949.394          8.746
      Distances      152     10805.422          9.573
    Az/Bearings      120      4143.120          6.671

          Total      330     15930.990          7.889

Warning: The Chi-Square Test at 5.00% Level Exceeded Upper Bound
                Lower/Upper Bounds (0.913/1.087)
```

Figure 4.9 Chi Square Test of station 3 that have been moved when checking with DIC

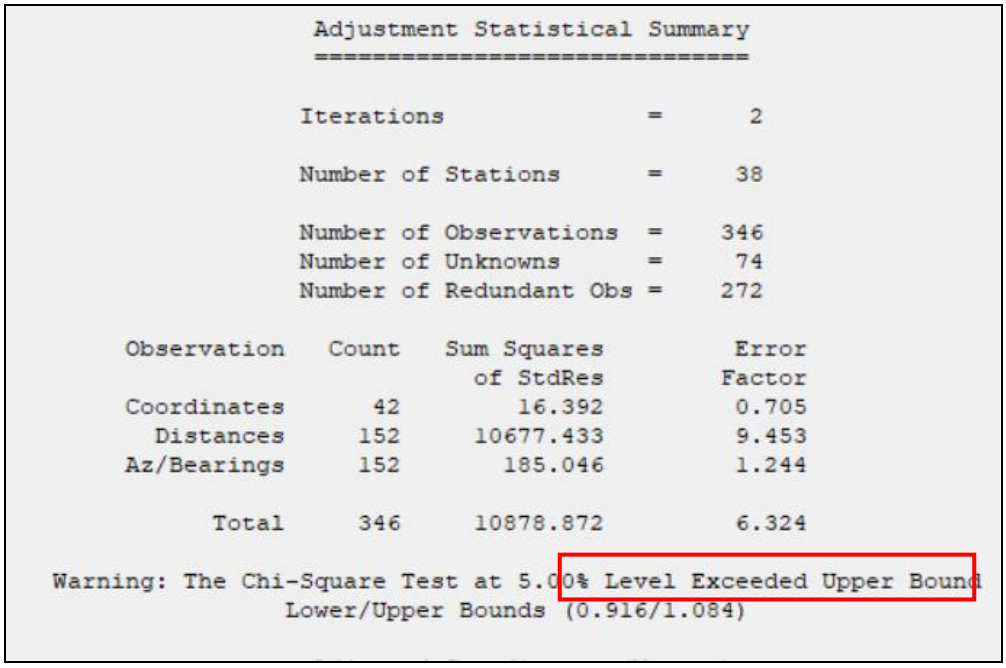
Table 4.7 shows that coordinate of true value and DIC after an adjustment.

TRUE VALUE			DIC adjustment coordinate		
Boundary marks	X	Y	Boundary marks	X	Y
23	1523.721	977.856	23	1560.256	977.870
24	1531.036	977.856	24	1545.626	977.867
25	1538.351	977.856	25	1574.887	977.875
26	1545.666	977.856	26	1567.572	977.873
27	1552.981	977.856	27	1530.996	977.863
28	1560.297	977.856	28	1523.681	977.861
29	1567.612	977.856	29	1552.941	977.869
30	1574.927	977.856	30	1538.311	977.865
31	1523.721	956.520	31	1560.262	956.534
32	1531.036	956.520	32	1552.947	956.533
33	1538.351	956.520	33	1574.892	956.539
34	1545.666	956.520	34	1567.578	956.537
35	1552.981	956.520	35	1531.002	956.526
36	1560.297	956.520	36	1523.686	956.524

37	1567.612	956.520	37	1545.632	956.531
38	1574.927	956.520	38	1538.318	956.529

4.2.3 Intersection

Figure 4.1 shows that Chi Square Test result when station 3 have been moved and the input file still using the same bearing and distance based on true values, but the Chi Square Test shown that the job has exceed upper bound level. Figure 4.2 shows that Chi Square Test result when intersect from station 4.



Adjustment Statistical Summary

Iterations = 2

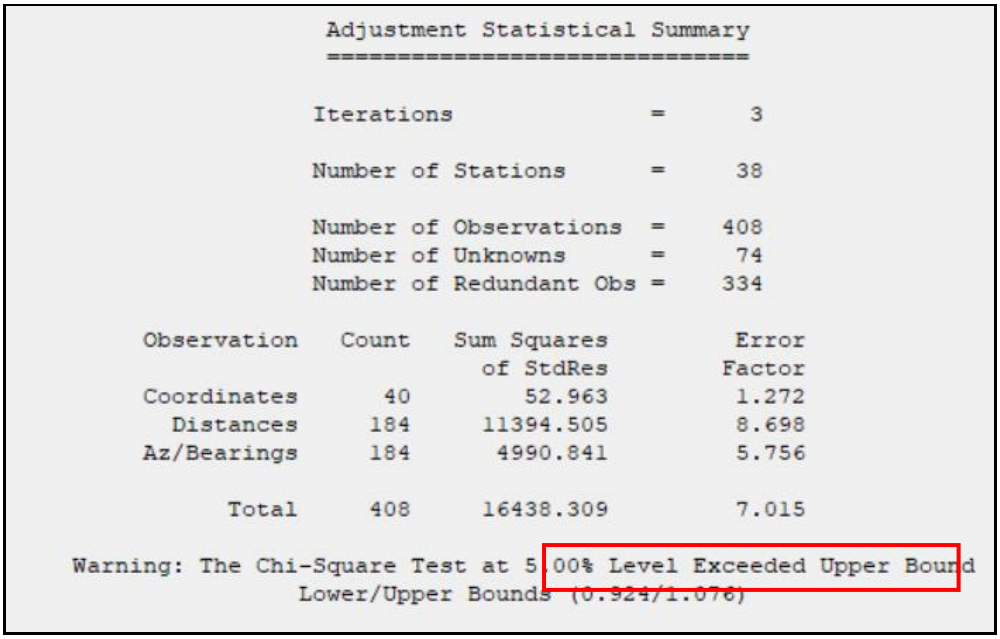
Number of Stations = 38

Number of Observations = 346
Number of Unknowns = 74
Number of Redundant Obs = 272

Observation	Count	Sum Squares of StdRes	Error Factor
Coordinates	42	16.392	0.705
Distances	152	10677.433	9.453
Az/Bearings	152	185.046	1.244
Total	346	10878.872	6.324

Warning: The Chi-Square Test at 5.00% Level Exceeded Upper Bound
Lower/Upper Bounds (0.916/1.084)

Figure 4.10 Chi Square Test result without intersection



```
                Adjustment Statistical Summary
                ==============================

               Iterations              =      3

               Number of Stations      =     38

               Number of Observations  =    408
               Number of Unknowns      =     74
               Number of Redundant Obs =    334

    Observation    Count    Sum Squares         Error
                              of StdRes        Factor
    Coordinates       40        52.963         1.272
      Distances      184     11394.505         8.698
    Az/Bearings      184      4990.841         5.756

          Total      408     16438.309         7.015

Warning: The Chi-Square Test at 5.00% Level Exceeded Upper Bound
              Lower/Upper Bounds (0.924/1.076)
```

Figure 4.11 Chi Square Test with intersection from station 4

Table 4.8 shows that coordinate of true value and value of coordinate after intersection after adjustment have been made.

TRUE VALUE			Intersection adjustment		
Boundary marks	X	Y	Boundary marks	X	Y
23	1523.721	977.856	23	1560.242	977.848
24	1531.036	977.856	24	1552.927	977.848
25	1538.351	977.856	25	1574.874	977.849
26	1545.666	977.856	26	1567.559	977.849
27	1552.981	977.856	27	1530.980	977.848
28	1560.297	977.856	28	1523.664	977.847
29	1567.612	977.856	29	1545.610	977.848
30	1574.927	977.856	30	1538.296	977.848
31	1523.721	956.520	31	1538.301	956.518
32	1531.036	956.520	32	1545.616	956.517
33	1538.351	956.520	33	1523.669	956.519
34	1545.666	956.520	34	1530.985	956.518
35	1552.981	956.520	35	1567.561	956.515
36	1560.297	956.520	36	1574.876	956.515

37	1567.612	956.520	37	1552.9312	956.5160
38	1574.927	956.520	38	1560.2461	956.5151

4.3 Analysis and Discussion

4.3.1 Residual bearing, distance and area of radiate method

From the Table 4.1 above shows that value of residual bearing, residual distance and residual area that has been radiate 50m from control points. The mean for distance is 00-00-03. The minimum value of residual bearing is – 00-00-18 after been adjusted in STAR*Net and maximum value of residual bearing is 00-00-23. The range for this residual after is 00-00-41. The standard deviation for 50 meters radiated is 00-00-12. As for residual distance, the mean is 0.000, minimum value is -0.002m, and maximum value is 0.002m. Range of this residual distance is 0.004m. The standard deviation distance for 50 meters radiate is 0.001m. As for residual area, the mean of this residual shows that -0.001m^2, the minimum value is -0.026m^2, the maximum value is 0.023m^2. The range for this area after been adjusted in STAR*Net is 0.049m^2. The standard deviation for this is 0.015m^2.

The result of radiate from distance 100m shows that mean of residual bearing are $00°00'02"$ with minimum residual bearing after been adjusted is $-00°01'05"$ and maximum residual bearing $00°01'14"$. The range for residual bearing shows that $-00°02'29"$between minimum and maximum residual bearing. The standard deviation for 100m radiate is $-00°00'33"$. The average of residual distance for 100m radiate is 0.000m. The minimum value after being adjusted using LSA for 100m radiate is -0.004m and maximum residual distance is 0.003m. The range of residual distance is 0.007m and the standard deviation for distance radiate from 100m is 0.002m. As for residual area, the mean of this residual shows that average of 100m is -0.005m^2. The minimum of residual area is -0.025m^2, maximum of residual area is 0.006m^2 and range between residual area is 0.031m^2. The standard deviation area from 100m radiate is 0.012m^2.

The result of radiate from distance 150m shows that mean of residual bearing are $00°00'03"$ with minimum value of residual bearing after been adjusted is $-00°01'10"$ and maximum residual bearing $00°01'13"$. The range for residual bearing shows that $-00°02'23"$ between minimum and maximum residual bearing. The standard deviation for 100m radiate is $-00°00'35"$. This show increasing value when radiate far from control points. The average of residual distance for 150m radiate is 0.000m. The minimum value after being adjusted using LSA for 100m radiate is -0.001m and maximum residual distance is 0.00m. The range of residual distance is 0.004m and the standard deviation for distance radiate from 100m is 0.001m. As for residual area, the mean of this residual shows that average of 100m is $0.006m^2$. The minimum value of residual area is -$0.008m^2$, maximum of residual area is $0.031m^2$ and range between residual area is $0.039m^2$. The standard deviation area from 150m radiate is $0.013m^2$.

The result of radiate from distance 200m shows that mean of residual bearing are $00°00'50"$ with minimum residual bearing after been adjusted is $-00°01'07"$ and maximum residual bearing $00°00'52"$. The range for residual bearing show that $-00°01'59"$between minimum and maximum residual bearing. The standard deviation for 100m radiate is $-00°00'33"$. The average of residual distance for 100m radiate is 0.000m. The minimum value after being adjusted using LSA for 100m radiate is -0.003m and maximum residual distance is 0.002m. The range of residual distance is 0.005m and the standard deviation for distance radiate from 200m is 0.001m. As for residual area, the mean of this residual shows that average of 200m is $0.004m^2$. The minimum value of residual area is -$0.029m^2$, maximum of residual area is $0.029m^2$ and range between residual area is $0.058m^2$. The standard deviation area from 200m radiate is $0.020m^2$.

The result of radiate from distance 250m shows that mean of residual bearing is -00°00'06" with minimum residual bearing after been adjusted is -00°01'56" and maximum residual bearing 00°02'41". The range for residual bearing shows that -00°04'37"between minimum and maximum residual bearing. The standard deviation for 250m radiate is 00°00'51". This is the highest standard deviation among others radiation distance. The average of residual distance for 250m radiate is 0.000m. The

minimum value after being adjusted using LSA for 250m radiate is -0.003m and maximum residual distance is 0.004m. The range of residual distance is 0.007m and the standard deviation for distance radiate from 100m is 0.002m. As for residual area, the mean of this residual shows that average of 250m is -0.003m^2. The minimum of residual area is -0.043m^2, maximum of residual area is 0.014m^2 and range between residual area is 0.057m^2. The standard deviation area from 250m radiate is 0.020m^2.

The result of radiate from distance 3000m shows that mean of residual bearing is 00°00'09" with minimum residual bearing after been adjusted is -00°01'32" and maximum residual bearing 00°01'14". The range for residual bearing shows that -00°02'46"between minimum and maximum residual bearing. The standard deviation for 300m radiate is 00°00'43". This is the one of the highest standard deviation among others radiation distance. The average of residual distance for 300m radiate is 0.001m. The minimum value after being adjusted using LSA for 300m radiate is -0.009m and maximum residual distance is 0.008m. The range of residual distance is 0.017m and the standard deviation for distance radiate from 300m is 0.003m. As for residual area, the mean of this residual shows that average of 300m is $0.027m^2$. The minimum of residual area is -0.093m^2., maximum of residual area is $0.056m^2$. and range between residual area is $0.149m^2$. The standard deviation area from 300m radiate is $0.053m^2$.

The result from table shows that the increasing value in mean, minimum, maximum, range and standard deviation after radiated from near and to far control points. A low standard deviation show that the data points tend to be close to the mean while a high standard deviation show that the data points are distributed over a wide range of values. In this case it is clearly indicates that the increasing value of the standard deviation shows that using radiate method far from the control points is not appropriately used for setting out the terrace house in least square adjustment environment. Figure 4.12, Figure 4.13 and figure 4.14 shows that residual graph in bearing, distance and area.

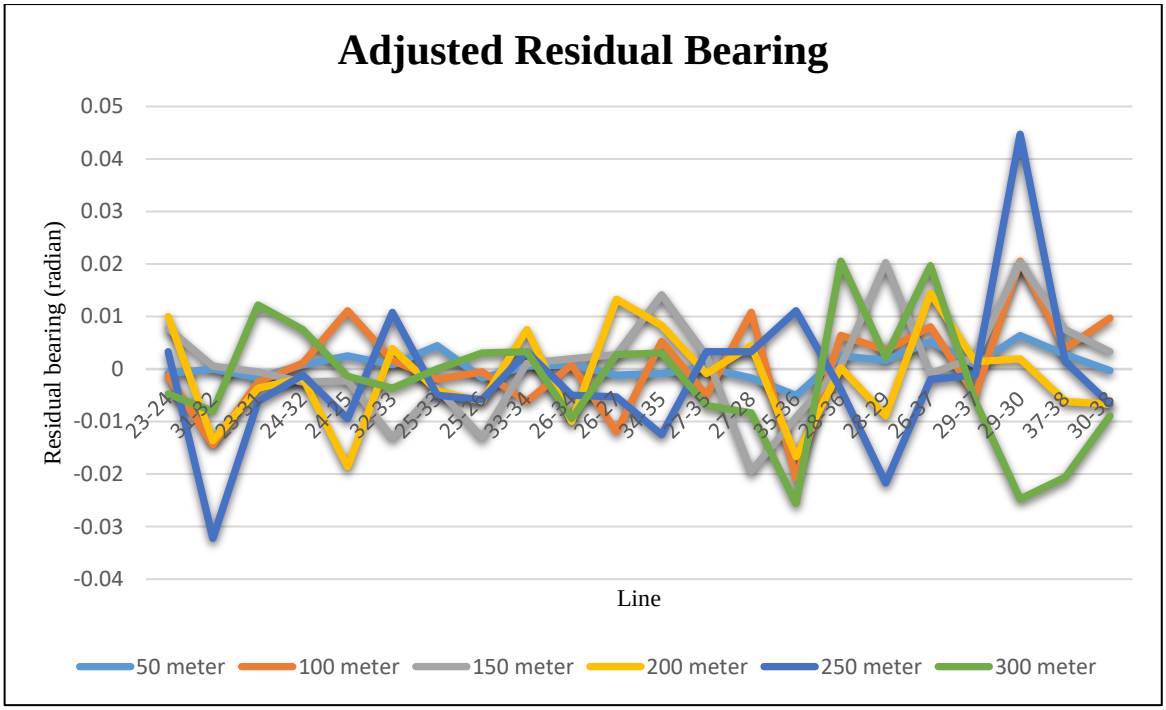


Figure 4.12 Graph of residual bearing after adjusted using Star*NET software

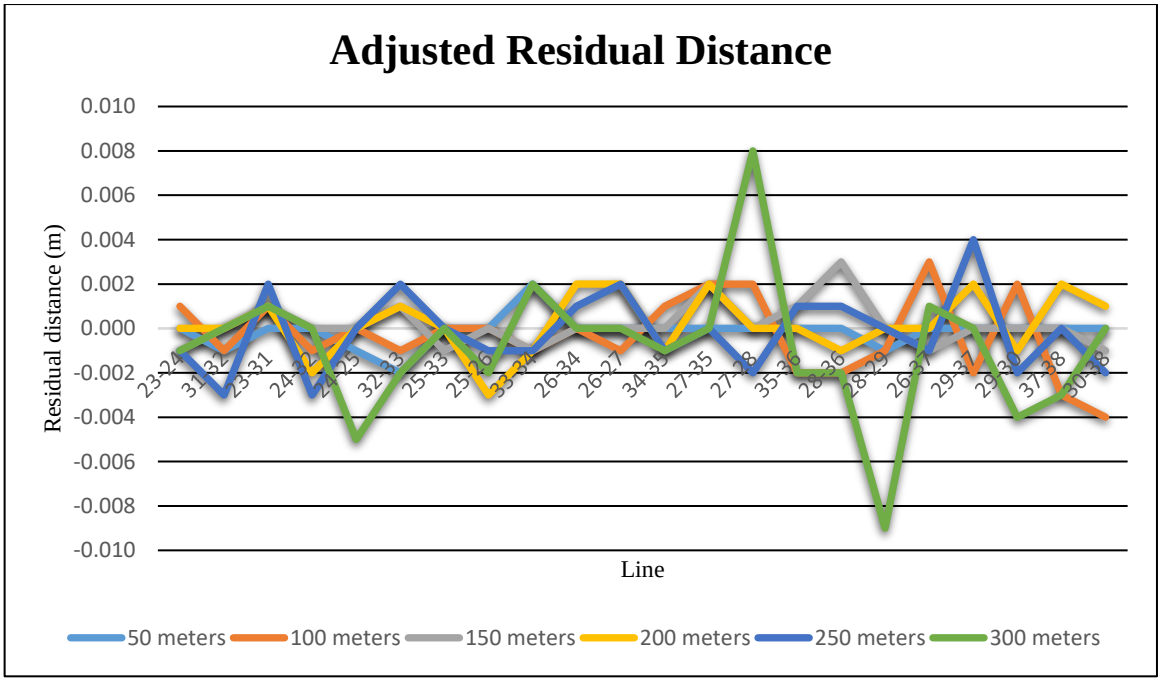


Figure 4.13 Graph of residual distance after adjusted using Star*NET software

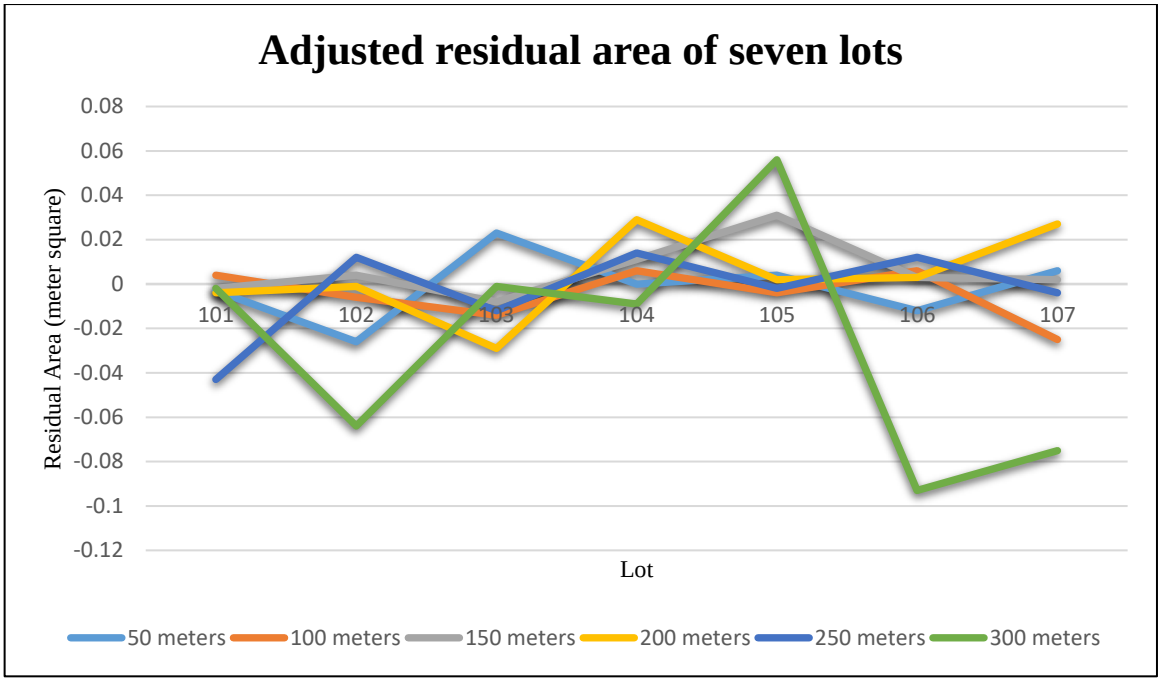


Figure 4.14 Graph of residual area after adjusted using Star*NET software

Graph in Figure 4.12 until Figure 4.14 shows that the value of residual bearing, distance and area that have been radiate from short distance until long distance have shown the increasing value of residual. This show that the longer radiate method was used for surveying works, the higher the residual in bearing, distance and area can be.

4.3.2 Double Independence Check (DIC) Analysis

The true value of DIC angle has been run on STAR*Net and compare with DIC after an adjustment have been made. The result from both of it show different Chi Square Test result between it. DIC with true value shows that the adjusted coordinate that have achieved a lower bound fence while DIC was performed on station 3 that have been moved shows that for that job it achieved an upper bound fence. In order to check whether station 3 has moved or not, DIC method should be carry out when using radiate method to ensure that all of on-line boundary marks should be in it place. Figure 4.5 shows that position of lot after been adjusted with LSA even though DIC method have been done. The cyan lot shows that lot after has perform DIC and black lot indicates the true position of where the lot would be. The differences of coordinates as stated on Table 4.7. Even after a geometry data checking procedure has been carry out, a Chi Square Test still give upper bound result means that of the station have been shifted.

Figure 4.6 shows that listing error from STAR*Net software shows that standard residual of line 3-4 after been adjusted.

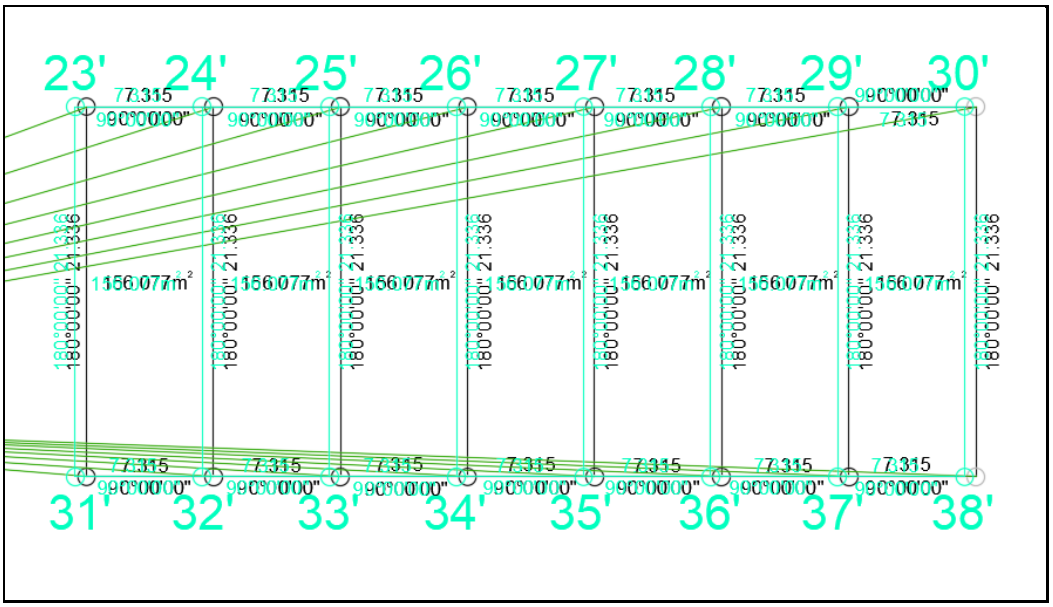


Figure 4.15 Cyan lot indicate to the position of lot after station have been moved

2	3	65.7857	-0.0263	0.0100	2.6	2:32
3	2	65.7857	-0.0273	0.0100	2.7	2:33
3	4	110.5591	0.5431	0.0100	54.3*	2:37
4	3	110.5591	0.5441	0.0100	54.4*	2:38
4	5	67.8541	-0.0419	0.0100	4.2*	2:42
5	4	67.8541	-0.0419	0.0100	4.2*	2:43

Figure 4.16 Listing error from STAR*Net software

4.3.3 Intersection Method Analysis

A geometry data checking using intersection have conduct between station 3 that have shift and station 4. In order to ensure either station 3 have shift or not, intersection method was used. Figure 4.6 shows that adjusted distance for line 3-4 and standard residual shows that a high error on that line. The STAR*Net software shows that on that particular line have error either that station has been shift or gross error have occurs during input data process. But for this case, all the gross error has been removed yet still get an upper bound fence.

1	2	61.1410	-0.0050	0.0100	0.5	2:26
2	1	61.1410	-0.0060	0.0100	0.6	2:27
2	3	65.7834	-0.0286	0.0100	2.9	2:31
3	2	65.7834	-0.0296	0.0100	3.0	2:32
3	4	110.4750	0.4590	0.0100	45.9*	2:36
4	3	110.4750	0.4600	0.0100	46.0*	2:37
4	5	67.8480	-0.0480	0.0100	4.8*	2:41
5	4	67.8480	-0.0480	0.0100	4.8*	2:42
5	6	67.9050	-0.0290	0.0100	2.9	2:46
6	5	67.9050	-0.0320	0.0100	3.2*	2:47

Figure 4.17 Listing error from STAR*Net

CHAPTER FIVE
CONCLUSION

To sum up this research this research has achieved its aim which are on how to apply the radiation method in on-line method in Least Square Adjustment environment. In order to make the successfulness of this study, three objectives have been set to achieved aim for this study. The first objective is to study the impact of on-line method based on single leg which is radiate method. Six distance have radiated from several control points to the terrace house from short distance to long distance from the control points. To result after adjustment shows that the different value between true value in terms of bearing, distance and area. A residual has been calculated using IBM SPSS Statistic software to calculate the mean, minimum, maximum, range and standard deviation for six distance. As the result shows that the longer distance has been radiate from control points, the increasing value of mean, minimum, maximum, range and standard deviation. The standard deviation for this study is a guideline when performing radiate method on field work, based on certain distance, the tolerance when radiate from short to long distance should be in tolerance as stated in Table 4.1 until Table 4.6

The second objective is to study the on-line method based on geometry data checking using double independent check (DIC) and intersection method. In order to apply the geometry data checking, one of the stations has been shifted to demonstrate the crucial of geometry data checking during on-line work. Even during field work surveyor set the true bearing but if the surveyor observed from the shifted station, all of the terrace house coordinates have been emplace on the wrong location. In order to prevent this from happening, a geometry data checking should be practice when performing radiate method in on-line work.

The third objective is to propose the new suggestion method procedure of geometry data checking during emplace boundary marks. This third objective is relating to the second objective. This geometry data checking should be proposed to the Department Survey and Mapping Malaysia resulting from the second objective from preventing all of the wrongly coordinate have been inserted to database.

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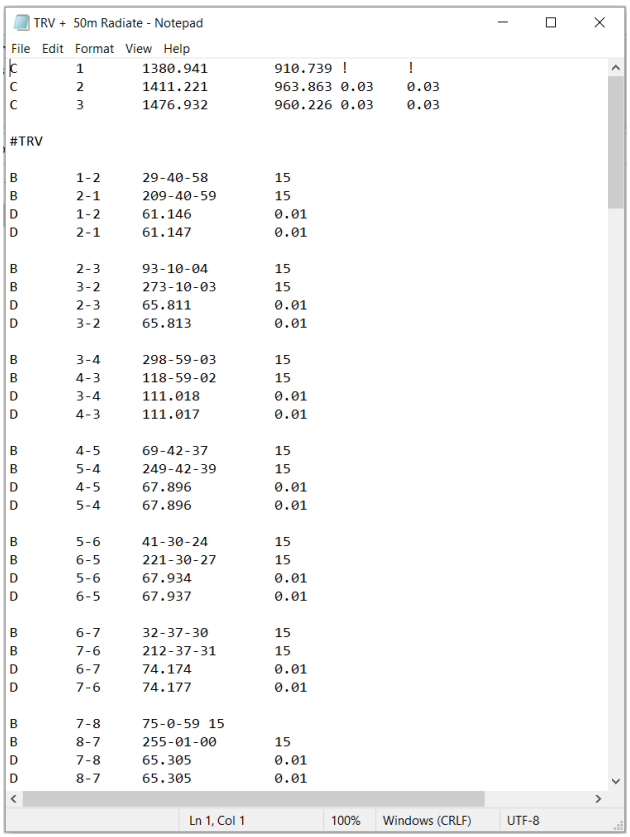
National Land Code (Act 56 of 1965) and Regulations.

APPENDIX

Appendix A: Input file traverse and 50m radiate

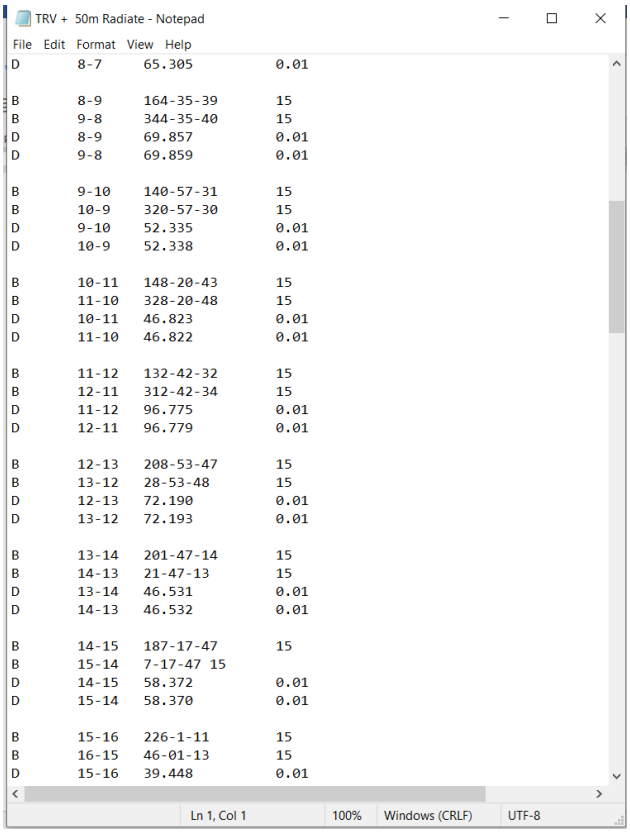


TRV + 50m Radiate - Notepad

File Edit Format View Help

```
C       1       1380.941        910.739 !       !
C       2       1411.221        963.863 0.03    0.03
C       3       1476.932        960.226 0.03    0.03

#TRV

B       1-2     29-40-58        15
B       2-1     209-40-59       15
D       1-2     61.146          0.01
D       2-1     61.147          0.01

B       2-3     93-10-04        15
B       3-2     273-10-03       15
D       2-3     65.811          0.01
D       3-2     65.813          0.01

B       3-4     298-59-03       15
B       4-3     118-59-02       15
D       3-4     111.018         0.01
D       4-3     111.017         0.01

B       4-5     69-42-37        15
B       5-4     249-42-39       15
D       4-5     67.896          0.01
D       5-4     67.896          0.01

B       5-6     41-30-24        15
B       6-5     221-30-27       15
D       5-6     67.934          0.01
D       6-5     67.937          0.01

B       6-7     32-37-30        15
B       7-6     212-37-31       15
D       6-7     74.174          0.01
D       7-6     74.177          0.01

B       7-8     75-0-59 15
B       8-7     255-01-00       15
D       7-8     65.305          0.01
D       8-7     65.305          0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8



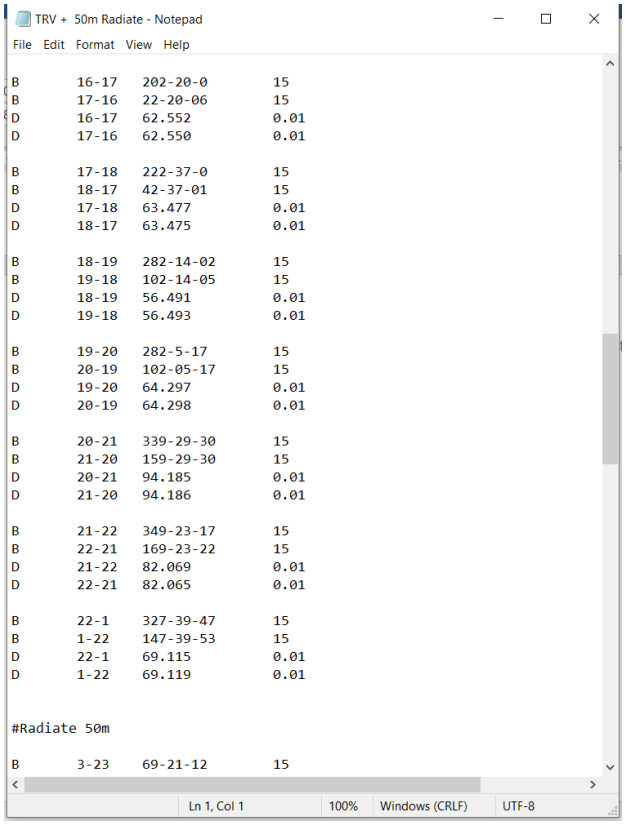
TRV + 50m Radiate - Notepad

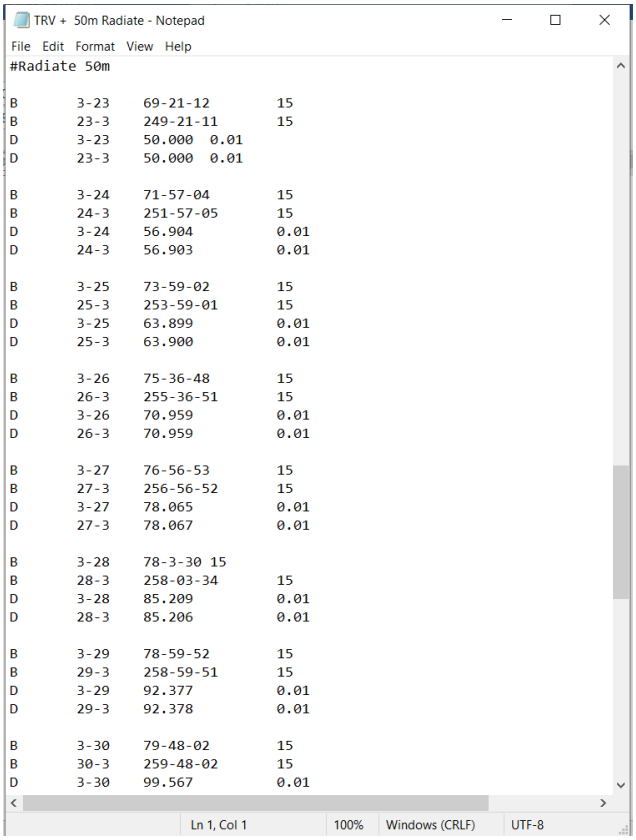
File Edit Format View Help

```
D       8-7     65.305          0.01

B       8-9     164-35-39       15
B       9-8     344-35-40       15
D       8-9     69.857          0.01
D       9-8     69.859          0.01

B       9-10    140-57-31       15
B       10-9    320-57-30       15
D       9-10    52.335          0.01
D       10-9    52.338          0.01

B       10-11   148-20-43       15
B       11-10   328-20-48       15
D       10-11   46.823          0.01
D       11-10   46.822          0.01

B       11-12   132-42-32       15
B       12-11   312-42-34       15
D       11-12   96.775          0.01
D       12-11   96.779          0.01

B       12-13   208-53-47       15
B       13-12   28-53-48        15
D       12-13   72.190          0.01
D       13-12   72.193          0.01

B       13-14   201-47-14       15
B       14-13   21-47-13        15
D       13-14   46.531          0.01
D       14-13   46.532          0.01

B       14-15   187-17-47       15
B       15-14   7-17-47 15
D       14-15   58.372          0.01
D       15-14   58.370          0.01

B       15-16   226-1-11        15
B       16-15   46-01-13        15
D       15-16   39.448          0.01
```

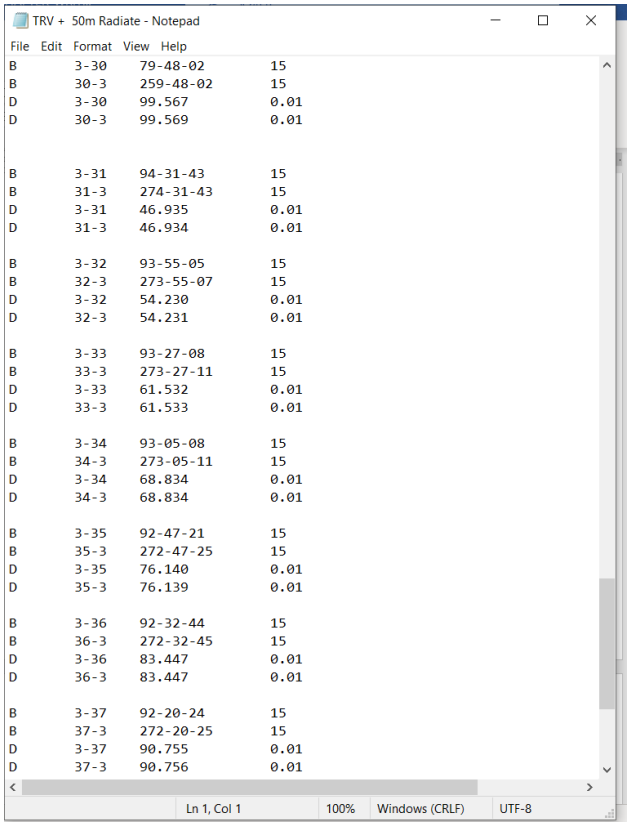
Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

Appendix A: Input file traverse and 50m radiate





Appendix A: Input file traverse and 50m radiate

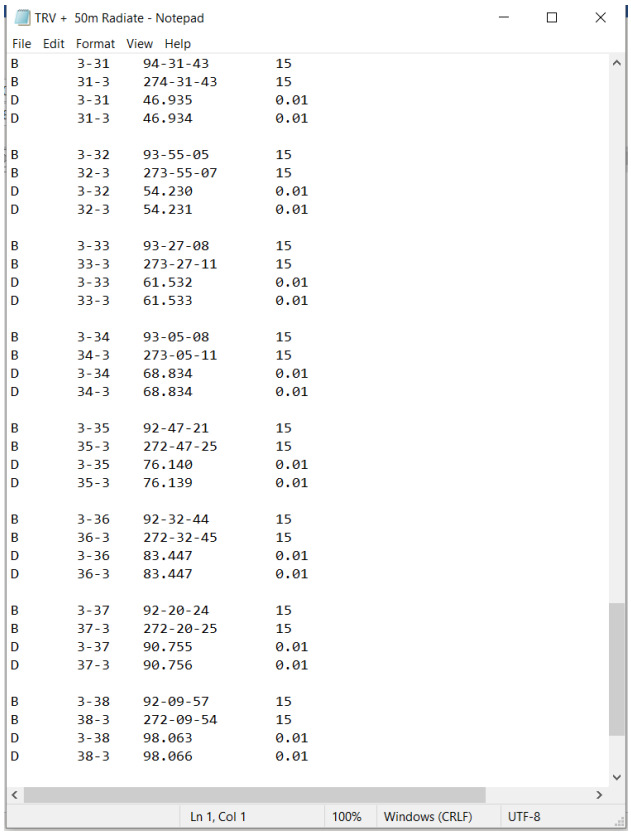


TRV + 50m Radiate - Notepad

File Edit Format View Help

```
B       3-30    79-48-02        15
B       30-3    259-48-02       15
D       3-30    99.567          0.01
D       30-3    99.569          0.01


B       3-31    94-31-43        15
B       31-3    274-31-43       15
D       3-31    46.935          0.01
D       31-3    46.934          0.01

B       3-32    93-55-05        15
B       32-3    273-55-07       15
D       3-32    54.230          0.01
D       32-3    54.231          0.01

B       3-33    93-27-08        15
B       33-3    273-27-11       15
D       3-33    61.532          0.01
D       33-3    61.533          0.01

B       3-34    93-05-08        15
B       34-3    273-05-11       15
D       3-34    68.834          0.01
D       34-3    68.834          0.01

B       3-35    92-47-21        15
B       35-3    272-47-25       15
D       3-35    76.140          0.01
D       35-3    76.139          0.01

B       3-36    92-32-44        15
B       36-3    272-32-45       15
D       3-36    83.447          0.01
D       36-3    83.447          0.01

B       3-37    92-20-24        15
B       37-3    272-20-25       15
D       3-37    90.755          0.01
D       37-3    90.756          0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8



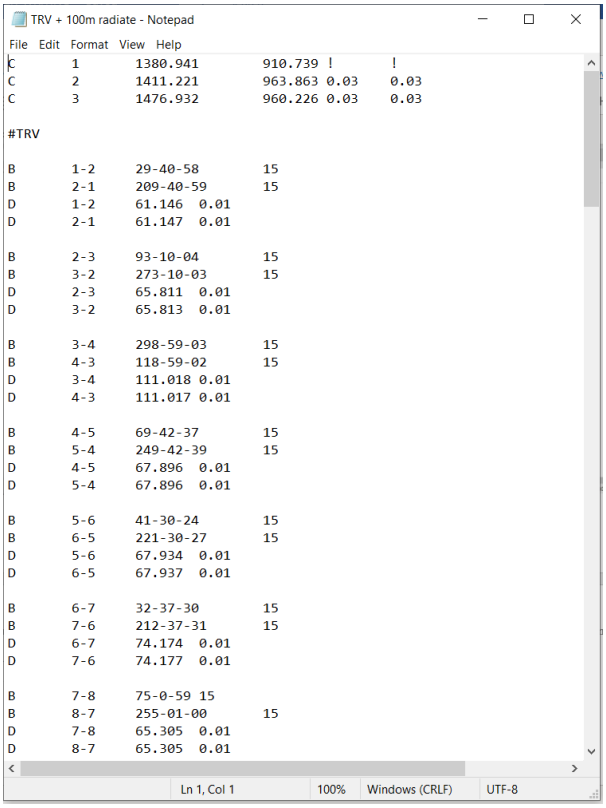
TRV + 50m Radiate - Notepad

File Edit Format View Help

```
B       3-31    94-31-43        15
B       31-3    274-31-43       15
D       3-31    46.935          0.01
D       31-3    46.934          0.01

B       3-32    93-55-05        15
B       32-3    273-55-07       15
D       3-32    54.230          0.01
D       32-3    54.231          0.01

B       3-33    93-27-08        15
B       33-3    273-27-11       15
D       3-33    61.532          0.01
D       33-3    61.533          0.01

B       3-34    93-05-08        15
B       34-3    273-05-11       15
D       3-34    68.834          0.01
D       34-3    68.834          0.01

B       3-35    92-47-21        15
B       35-3    272-47-25       15
D       3-35    76.140          0.01
D       35-3    76.139          0.01

B       3-36    92-32-44        15
B       36-3    272-32-45       15
D       3-36    83.447          0.01
D       36-3    83.447          0.01

B       3-37    92-20-24        15
B       37-3    272-20-25       15
D       3-37    90.755          0.01
D       37-3    90.756          0.01

B       3-38    92-09-57        15
B       38-3    272-09-54       15
D       3-38    98.063          0.01
D       38-3    98.066          0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

Appendix B: Input file traverse and 100m radiate

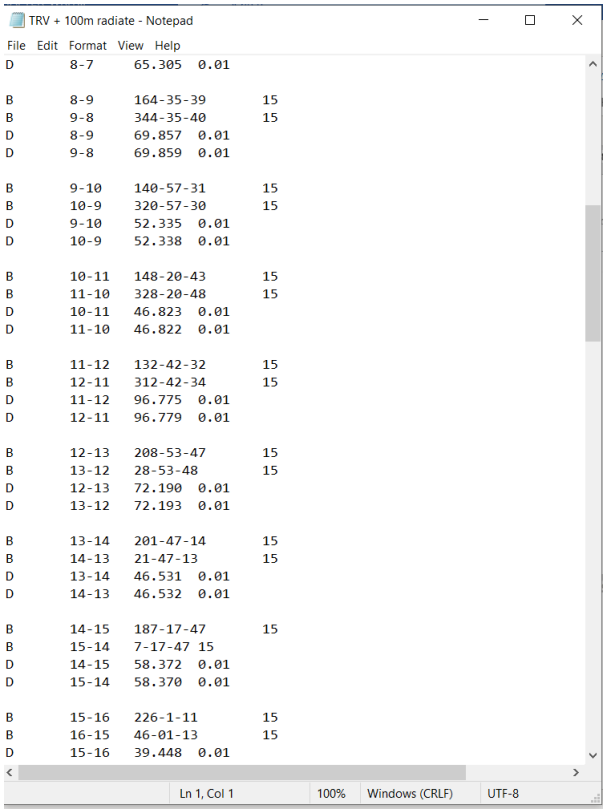


TRV + 100m radiate - Notepad

File Edit Format View Help

```
C       1       1380.941        910.739 !       !
C       2       1411.221        963.863 0.03    0.03
C       3       1476.932        960.226 0.03    0.03

#TRV

B       1-2     29-40-58        15
B       2-1     209-40-59       15
D       1-2     61.146  0.01
D       2-1     61.147  0.01

B       2-3     93-10-04        15
B       3-2     273-10-03       15
D       2-3     65.811  0.01
D       3-2     65.813  0.01

B       3-4     298-59-03       15
B       4-3     118-59-02       15
D       3-4     111.018 0.01
D       4-3     111.017 0.01

B       4-5     69-42-37        15
B       5-4     249-42-39       15
D       4-5     67.896  0.01
D       5-4     67.896  0.01

B       5-6     41-30-24        15
B       6-5     221-30-27       15
D       5-6     67.934  0.01
D       6-5     67.937  0.01

B       6-7     32-37-30        15
B       7-6     212-37-31       15
D       6-7     74.174  0.01
D       7-6     74.177  0.01

B       7-8     75-0-59 15
B       8-7     255-01-00       15
D       7-8     65.305  0.01
D       8-7     65.305  0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

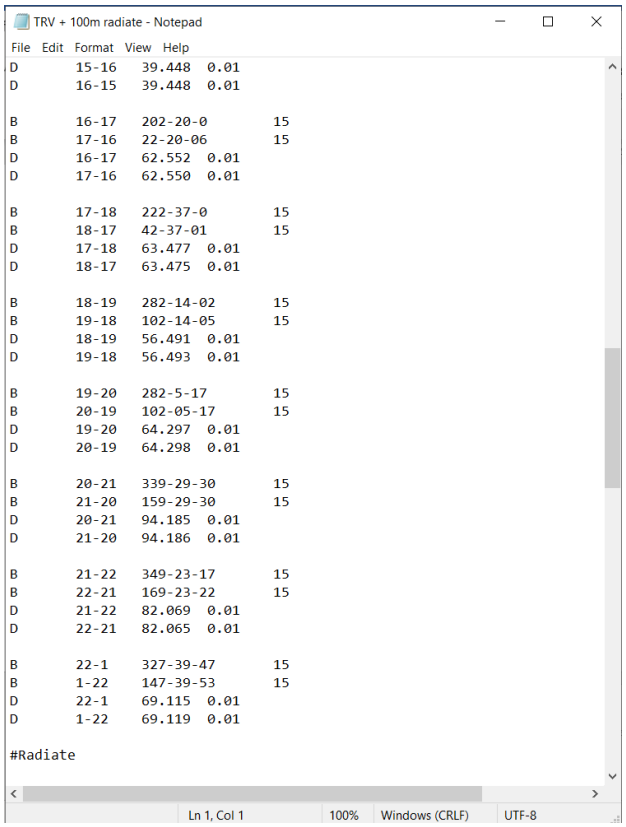


TRV + 100m radiate - Notepad

File Edit Format View Help

```
D       8-7     65.305  0.01

B       8-9     164-35-39       15
B       9-8     344-35-40       15
D       8-9     69.857  0.01
D       9-8     69.859  0.01

B       9-10    140-57-31       15
B       10-9    320-57-30       15
D       9-10    52.335  0.01
D       10-9    52.338  0.01

B       10-11   148-20-43       15
B       11-10   328-20-48       15
D       10-11   46.823  0.01
D       11-10   46.822  0.01

B       11-12   132-42-32       15
B       12-11   312-42-34       15
D       11-12   96.775  0.01
D       12-11   96.779  0.01

B       12-13   208-53-47       15
B       13-12   28-53-48        15
D       12-13   72.190  0.01
D       13-12   72.193  0.01

B       13-14   201-47-14       15
B       14-13   21-47-13        15
D       13-14   46.531  0.01
D       14-13   46.532  0.01

B       14-15   187-17-47       15
B       15-14   7-17-47 15
D       14-15   58.372  0.01
D       15-14   58.370  0.01

B       15-16   226-1-11        15
B       16-15   46-01-13        15
D       15-16   39.448  0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

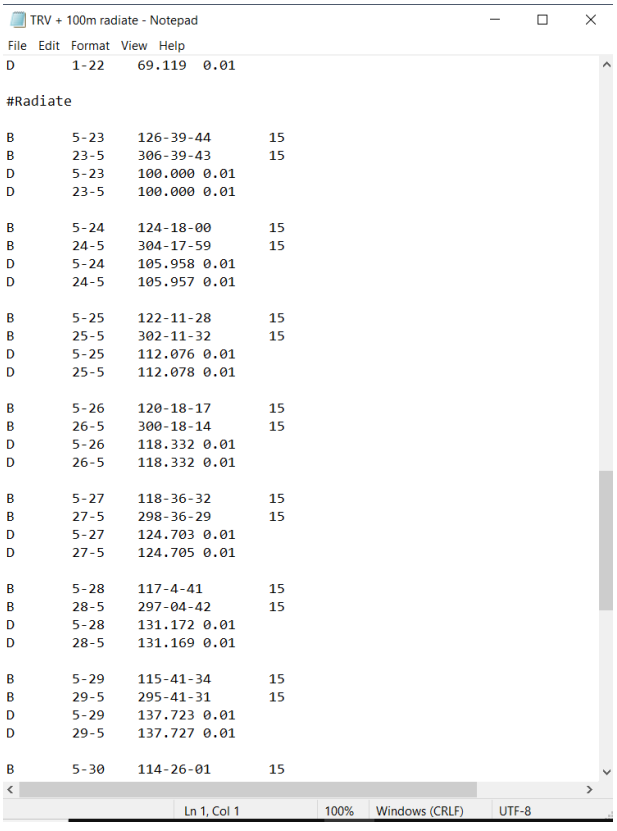


TRV + 100m radiate - Notepad

File Edit Format View Help

```
D       15-16   39.448  0.01
D       16-15   39.448  0.01

B       16-17   202-20-0        15
B       17-16   22-20-06        15
D       16-17   62.552  0.01
D       17-16   62.550  0.01

B       17-18   222-37-0        15
B       18-17   42-37-01        15
D       17-18   63.477  0.01
D       18-17   63.475  0.01

B       18-19   282-14-02       15
B       19-18   102-14-05       15
D       18-19   56.491  0.01
D       19-18   56.493  0.01

B       19-20   282-5-17        15
B       20-19   102-05-17       15
D       19-20   64.297  0.01
D       20-19   64.298  0.01

B       20-21   339-29-30       15
B       21-20   159-29-30       15
D       20-21   94.185  0.01
D       21-20   94.186  0.01

B       21-22   349-23-17       15
B       22-21   169-23-22       15
D       21-22   82.069  0.01
D       22-21   82.065  0.01

B       22-1    327-39-47       15
B       1-22    147-39-53       15
D       22-1    69.115  0.01
D       1-22    69.119  0.01

#Radiate
```

Ln 1, Col 1 100% Windows (CRLF) UTF-8



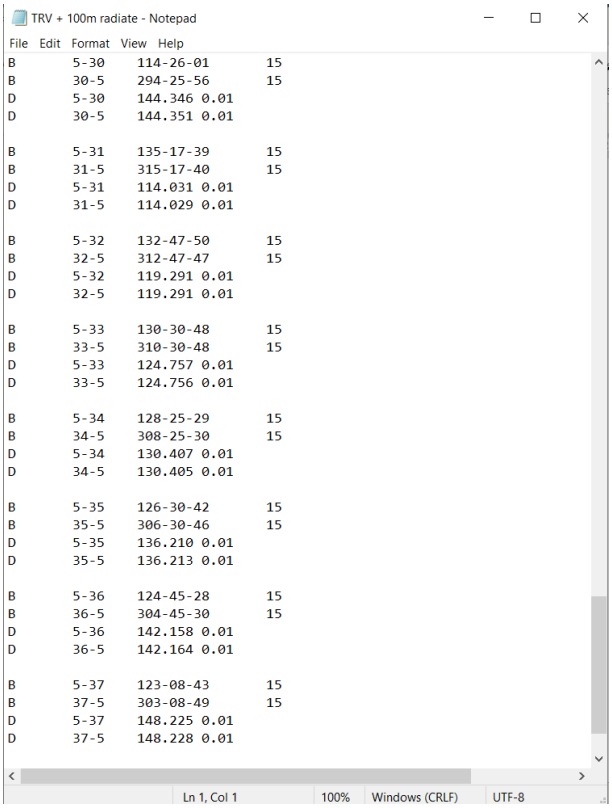
TRV + 100m radiate - Notepad

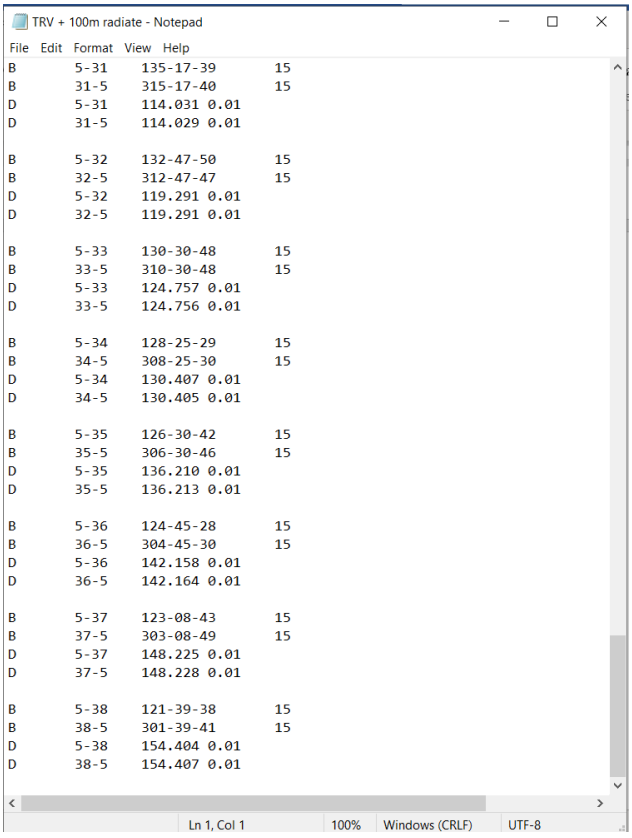
File Edit Format View Help

```
D       1-22    69.119  0.01

#Radiate

B       5-23    126-39-44       15
B       23-5    306-39-43       15
D       5-23    100.000 0.01
D       23-5    100.000 0.01

B       5-24    124-18-00       15
B       24-5    304-17-59       15
D       5-24    105.958 0.01
D       24-5    105.957 0.01

B       5-25    122-11-28       15
B       25-5    302-11-32       15
D       5-25    112.076 0.01
D       25-5    112.078 0.01

B       5-26    120-18-17       15
B       26-5    300-18-14       15
D       5-26    118.332 0.01
D       26-5    118.332 0.01

B       5-27    118-36-32       15
B       27-5    298-36-29       15
D       5-27    124.703 0.01
D       27-5    124.705 0.01

B       5-28    117-4-41        15
B       28-5    297-04-42       15
D       5-28    131.172 0.01
D       28-5    131.169 0.01

B       5-29    115-41-34       15
B       29-5    295-41-31       15
D       5-29    137.723 0.01
D       29-5    137.727 0.01

B       5-30    114-26-01       15
```

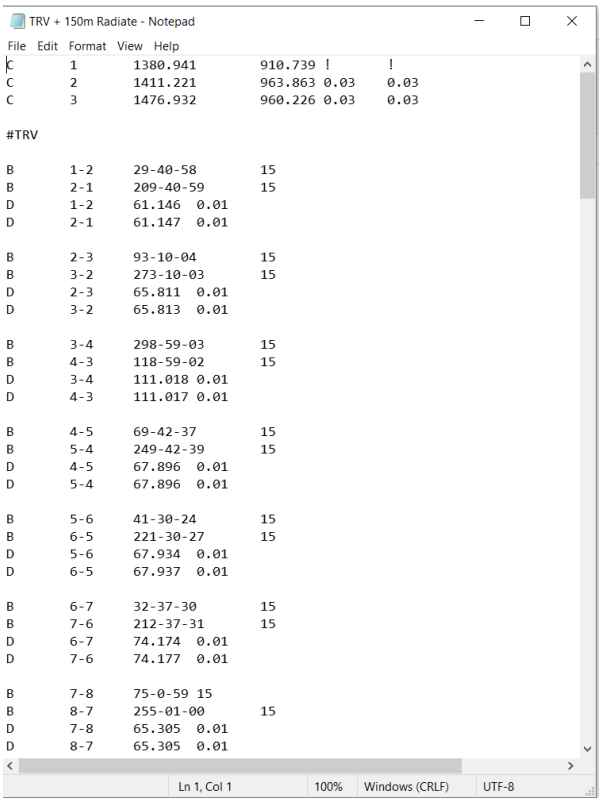
Ln 1, Col 1 100% Windows (CRLF) UTF-8

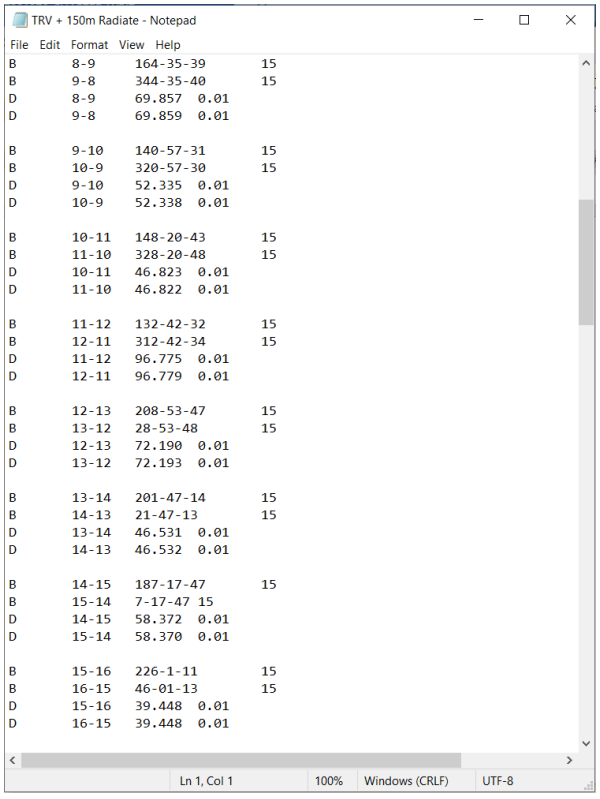
Appendix B: Input file traverse and 100m radiate



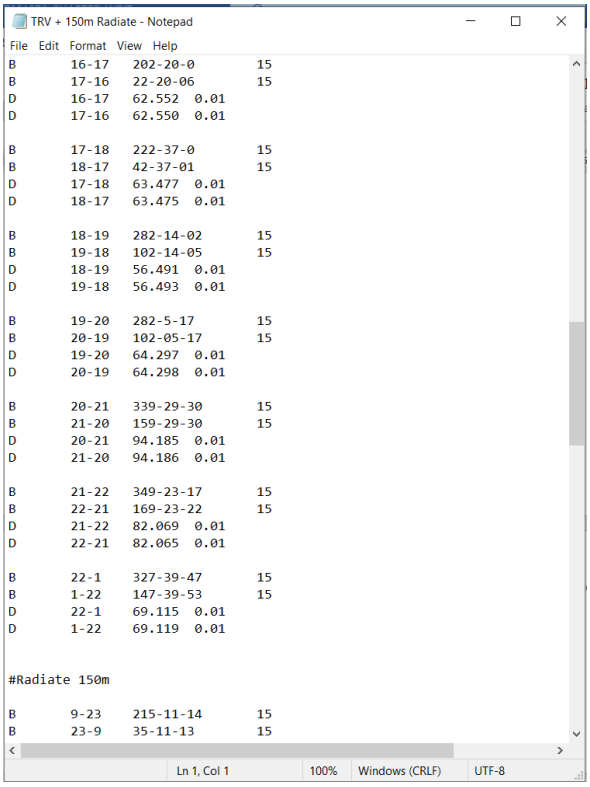


Appendix C: Input file traverse and 150m radiate





Appendix C: Input file traverse and 150m radiate

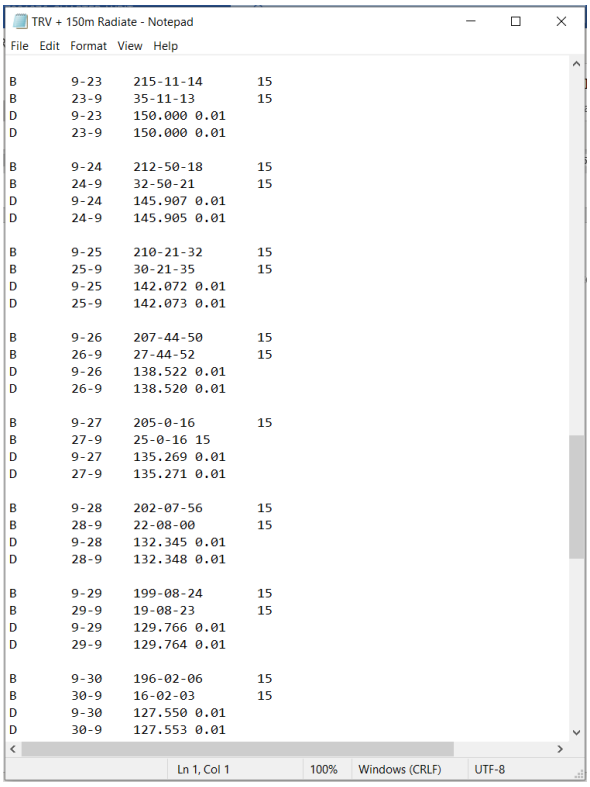


TRV + 150m Radiate - Notepad

File Edit Format View Help

```
B       16-17   202-20-0        15
B       17-16   22-20-06        15
D       16-17   62.552  0.01
D       17-16   62.550  0.01

B       17-18   222-37-0        15
B       18-17   42-37-01        15
D       17-18   63.477  0.01
D       18-17   63.475  0.01

B       18-19   282-14-02       15
B       19-18   102-14-05       15
D       18-19   56.491  0.01
D       19-18   56.493  0.01

B       19-20   282-5-17        15
B       20-19   102-05-17       15
D       19-20   64.297  0.01
D       20-19   64.298  0.01

B       20-21   339-29-30       15
B       21-20   159-29-30       15
D       20-21   94.185  0.01
D       21-20   94.186  0.01

B       21-22   349-23-17       15
B       22-21   169-23-22       15
D       21-22   82.069  0.01
D       22-21   82.065  0.01

B       22-1    327-39-47       15
B       1-22    147-39-53       15
D       22-1    69.115  0.01
D       1-22    69.119  0.01


#Radiate 150m

B       9-23    215-11-14       15
B       23-9    35-11-13        15
```

Ln 1, Col 1 100% Windows (CRLF) UTF-8



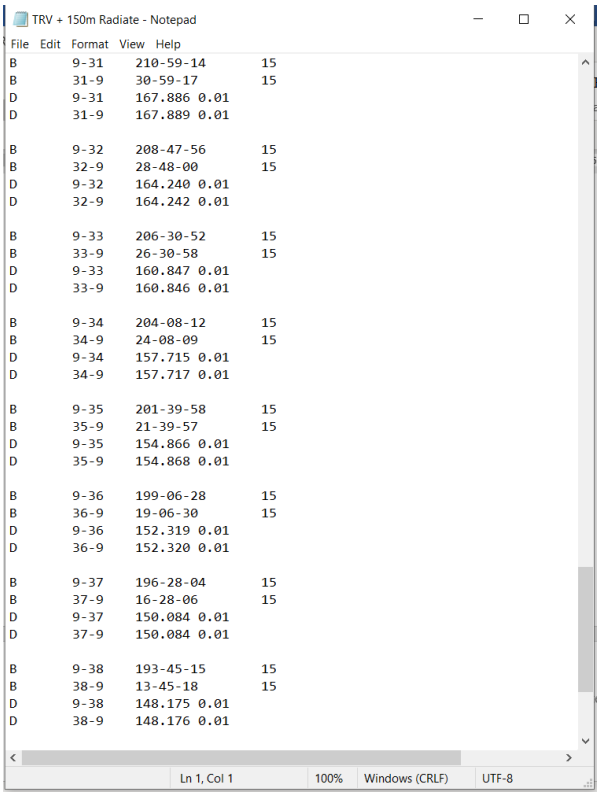
TRV + 150m Radiate - Notepad

File Edit Format View Help

```
B       9-23    215-11-14       15
B       23-9    35-11-13        15
D       9-23    150.000 0.01
D       23-9    150.000 0.01

B       9-24    212-50-18       15
B       24-9    32-50-21        15
D       9-24    145.907 0.01
D       24-9    145.905 0.01

B       9-25    210-21-32       15
B       25-9    30-21-35        15
D       9-25    142.072 0.01
D       25-9    142.073 0.01

B       9-26    207-44-50       15
B       26-9    27-44-52        15
D       9-26    138.522 0.01
D       26-9    138.520 0.01

B       9-27    205-0-16        15
B       27-9    25-0-16 15
D       9-27    135.269 0.01
D       27-9    135.271 0.01

B       9-28    202-07-56       15
B       28-9    22-08-00        15
D       9-28    132.345 0.01
D       28-9    132.348 0.01

B       9-29    199-08-24       15
B       29-9    19-08-23        15
D       9-29    129.766 0.01
D       29-9    129.764 0.01

B       9-30    196-02-06       15
B       30-9    16-02-03        15
D       9-30    127.550 0.01
D       30-9    127.553 0.01
```

Ln 1, Col 1 100% Windows (CRLF) UTF-8

Appendix C: Input file traverse and 150m radiate



Appendix D: Input file traverse and 200m radiate

TRV + 200m Radiate - Notepad

File Edit Format View Help

```
C       1       1380.941        910.739 !       !
C       2       1411.221        963.863 0.03    0.03
C       3       1476.932        960.226 0.03    0.03

#TRV

B       1-2     29-40-58        15
B       2-1     209-40-59       15
D       1-2     61.146  0.01
D       2-1     61.147  0.01

B       2-3     93-10-04        15
B       3-2     273-10-03       15
D       2-3     65.811  0.01
D       3-2     65.813  0.01

B       3-4     298-59-03       15
B       4-3     118-59-02       15
D       3-4     111.018 0.01
D       4-3     111.017 0.01

B       4-5     69-42-37        15
B       5-4     249-42-39       15
D       4-5     67.896  0.01
D       5-4     67.896  0.01

B       5-6     41-30-24        15
B       6-5     221-30-27       15
D       5-6     67.934  0.01
D       6-5     67.937  0.01

B       6-7     32-37-30        15
B       7-6     212-37-31       15
D       6-7     74.174  0.01
D       7-6     74.177  0.01

B       7-8     75-0-59 15
B       8-7     255-01-00       15
D       7-8     65.305  0.01
D       8-7     65.305  0.01
```

Ln 1, Col 1 100% Windows (CRLF) UTF-8

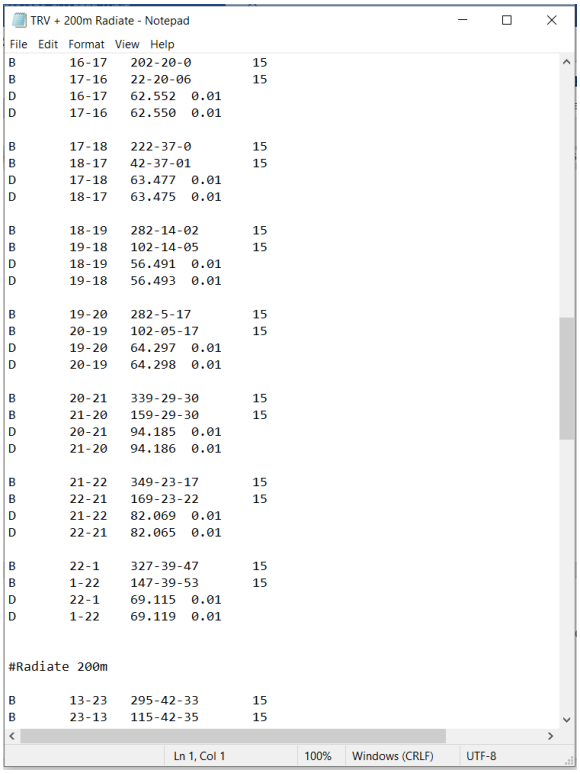
TRV + 200m Radiate - Notepad

File Edit Format View Help

```
B       8-9     164-35-39       15
B       9-8     344-35-40       15
D       8-9     69.857  0.01
D       9-8     69.859  0.01

B       9-10    140-57-31       15
B       10-9    320-57-30       15
D       9-10    52.335  0.01
D       10-9    52.338  0.01

B       10-11   148-20-43       15
B       11-10   328-20-48       15
D       10-11   46.823  0.01
D       11-10   46.822  0.01

B       11-12   132-42-32       15
B       12-11   312-42-34       15
D       11-12   96.775  0.01
D       12-11   96.779  0.01

B       12-13   208-53-47       15
B       13-12   28-53-48        15
D       12-13   72.190  0.01
D       13-12   72.193  0.01

B       13-14   201-47-14       15
B       14-13   21-47-13        15
D       13-14   46.531  0.01
D       14-13   46.532  0.01

B       14-15   187-17-47       15
B       15-14   7-17-47 15
D       14-15   58.372  0.01
D       15-14   58.370  0.01

B       15-16   226-1-11        15
B       16-15   46-01-13        15
D       15-16   39.448  0.01
D       16-15   39.448  0.01
```

Ln 1, Col 1 100% Windows (CRLF) UTF-8

Appendix D: Input file traverse and 200m radiate

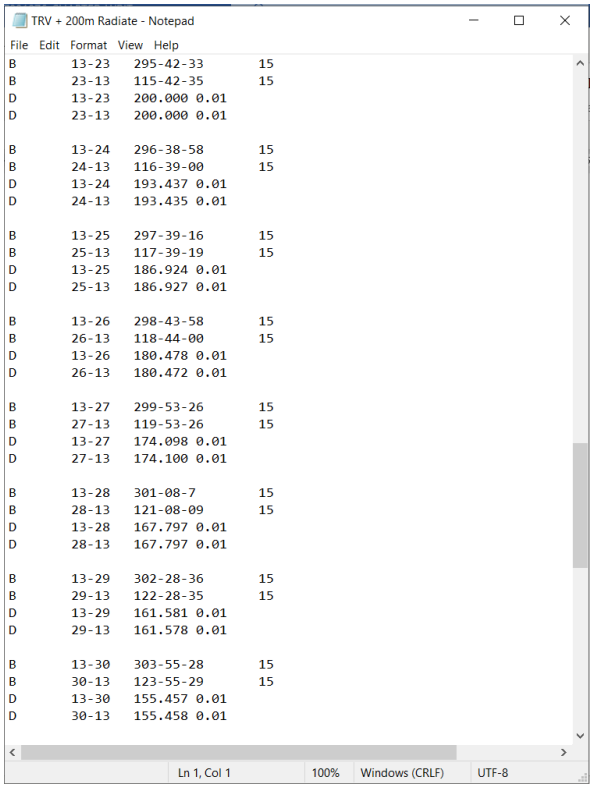


TRV + 200m Radiate - Notepad

File Edit Format View Help

```
B       16-17   202-20-0        15
B       17-16   22-20-06        15
D       16-17   62.552  0.01
D       17-16   62.550  0.01

B       17-18   222-37-0        15
B       18-17   42-37-01        15
D       17-18   63.477  0.01
D       18-17   63.475  0.01

B       18-19   282-14-02       15
B       19-18   102-14-05       15
D       18-19   56.491  0.01
D       19-18   56.493  0.01

B       19-20   282-5-17        15
B       20-19   102-05-17       15
D       19-20   64.297  0.01
D       20-19   64.298  0.01

B       20-21   339-29-30       15
B       21-20   159-29-30       15
D       20-21   94.185  0.01
D       21-20   94.186  0.01

B       21-22   349-23-17       15
B       22-21   169-23-22       15
D       21-22   82.069  0.01
D       22-21   82.065  0.01

B       22-1    327-39-47       15
B       1-22    147-39-53       15
D       22-1    69.115  0.01
D       1-22    69.119  0.01


#Radiate 200m

B       13-23   295-42-33       15
B       23-13   115-42-35       15
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8



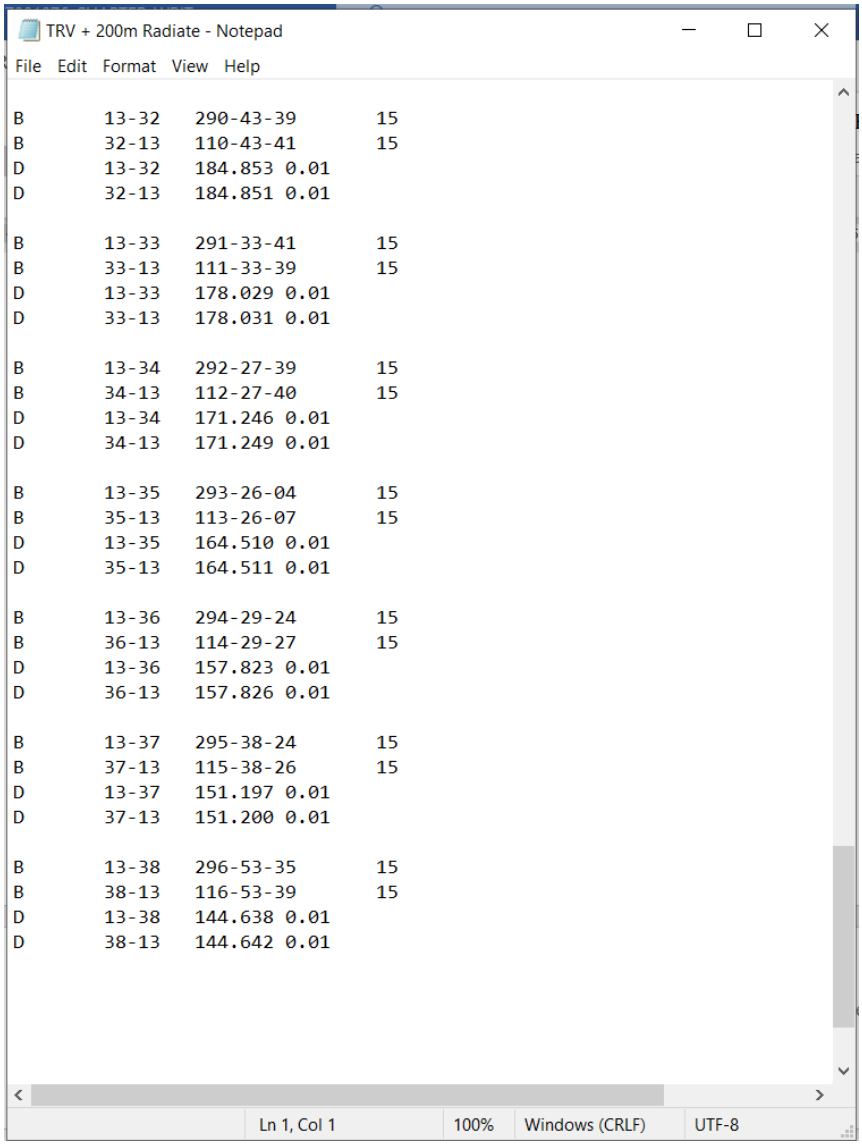
TRV + 200m Radiate - Notepad

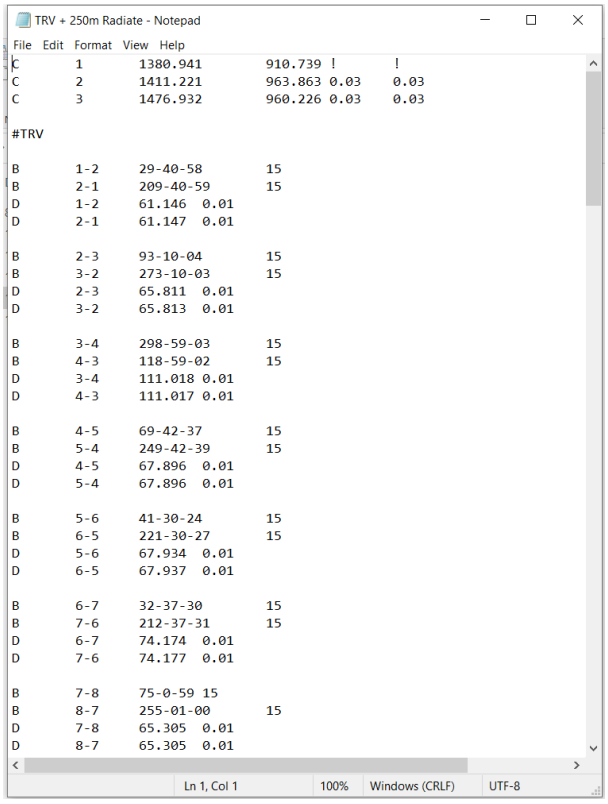
File Edit Format View Help

```
B       13-23   295-42-33       15
B       23-13   115-42-35       15
D       13-23   200.000 0.01
D       23-13   200.000 0.01

B       13-24   296-38-58       15
B       24-13   116-39-00       15
D       13-24   193.437 0.01
D       24-13   193.435 0.01

B       13-25   297-39-16       15
B       25-13   117-39-19       15
D       13-25   186.924 0.01
D       25-13   186.927 0.01

B       13-26   298-43-58       15
B       26-13   118-44-00       15
D       13-26   180.478 0.01
D       26-13   180.472 0.01

B       13-27   299-53-26       15
B       27-13   119-53-26       15
D       13-27   174.098 0.01
D       27-13   174.100 0.01

B       13-28   301-08-7        15
B       28-13   121-08-09       15
D       13-28   167.797 0.01
D       28-13   167.797 0.01

B       13-29   302-28-36       15
B       29-13   122-28-35       15
D       13-29   161.581 0.01
D       29-13   161.578 0.01

B       13-30   303-55-28       15
B       30-13   123-55-29       15
D       13-30   155.457 0.01
D       30-13   155.458 0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

Appendix D: Input file traverse and 200m radiate



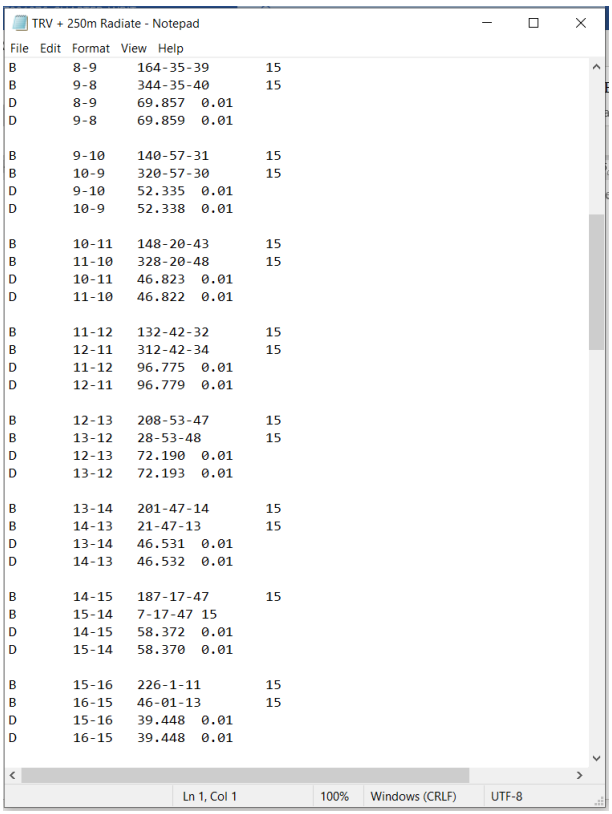


TRV + 250m Radiate - Notepad

File Edit Format View Help

```
C       1       1380.941        910.739 !       !
C       2       1411.221        963.863 0.03    0.03
C       3       1476.932        960.226 0.03    0.03

#TRV

B       1-2     29-40-58        15
B       2-1     209-40-59       15
D       1-2     61.146  0.01
D       2-1     61.147  0.01

B       2-3     93-10-04        15
B       3-2     273-10-03       15
D       2-3     65.811  0.01
D       3-2     65.813  0.01

B       3-4     298-59-03       15
B       4-3     118-59-02       15
D       3-4     111.018 0.01
D       4-3     111.017 0.01

B       4-5     69-42-37        15
B       5-4     249-42-39       15
D       4-5     67.896  0.01
D       5-4     67.896  0.01

B       5-6     41-30-24        15
B       6-5     221-30-27       15
D       5-6     67.934  0.01
D       6-5     67.937  0.01

B       6-7     32-37-30        15
B       7-6     212-37-31       15
D       6-7     74.174  0.01
D       7-6     74.177  0.01

B       7-8     75-0-59 15
B       8-7     255-01-00       15
D       7-8     65.305  0.01
D       8-7     65.305  0.01
```

Ln 1, Col 1 100% Windows (CRLF) UTF-8



TRV + 250m Radiate - Notepad

File Edit Format View Help

```
B       8-9     164-35-39       15
B       9-8     344-35-40       15
D       8-9     69.857  0.01
D       9-8     69.859  0.01

B       9-10    140-57-31       15
B       10-9    320-57-30       15
D       9-10    52.335  0.01
D       10-9    52.338  0.01

B       10-11   148-20-43       15
B       11-10   328-20-48       15
D       10-11   46.823  0.01
D       11-10   46.822  0.01

B       11-12   132-42-32       15
B       12-11   312-42-34       15
D       11-12   96.775  0.01
D       12-11   96.779  0.01

B       12-13   208-53-47       15
B       13-12   28-53-48        15
D       12-13   72.190  0.01
D       13-12   72.193  0.01

B       13-14   201-47-14       15
B       14-13   21-47-13        15
D       13-14   46.531  0.01
D       14-13   46.532  0.01

B       14-15   187-17-47       15
B       15-14   7-17-47 15
D       14-15   58.372  0.01
D       15-14   58.370  0.01

B       15-16   226-1-11        15
B       16-15   46-01-13        15
D       15-16   39.448  0.01
D       16-15   39.448  0.01
```

Ln 1, Col 1 100% Windows (CRLF) UTF-8

Appendix E: Input file traverse and 250m radiate

TRV + 250m Radiate - Notepad

File Edit Format View Help

```
B       16-17   202-20-0        15
B       17-16   22-20-06        15
D       16-17   62.552  0.01
D       17-16   62.550  0.01

B       17-18   222-37-0        15
B       18-17   42-37-01        15
D       17-18   63.477  0.01
D       18-17   63.475  0.01

B       18-19   282-14-02       15
B       19-18   102-14-05       15
D       18-19   56.491  0.01
D       19-18   56.493  0.01

B       19-20   282-5-17        15
B       20-19   102-05-17       15
D       19-20   64.297  0.01
D       20-19   64.298  0.01

B       20-21   339-29-30       15
B       21-20   159-29-30       15
D       20-21   94.185  0.01
D       21-20   94.186  0.01

B       21-22   349-23-17       15
B       22-21   169-23-22       15
D       21-22   82.069  0.01
D       22-21   82.065  0.01

B       22-1    327-39-47       15
B       1-22    147-39-53       15
D       22-1    69.115  0.01
D       1-22    69.119  0.01

#Radiate 250m

B       16-23   329-26-03       15
B       23-16   149-26-05       15
D       16-23   250.000 0.01
```

Ln 1, Col 1 100% Windows (CRLF) UTF-8

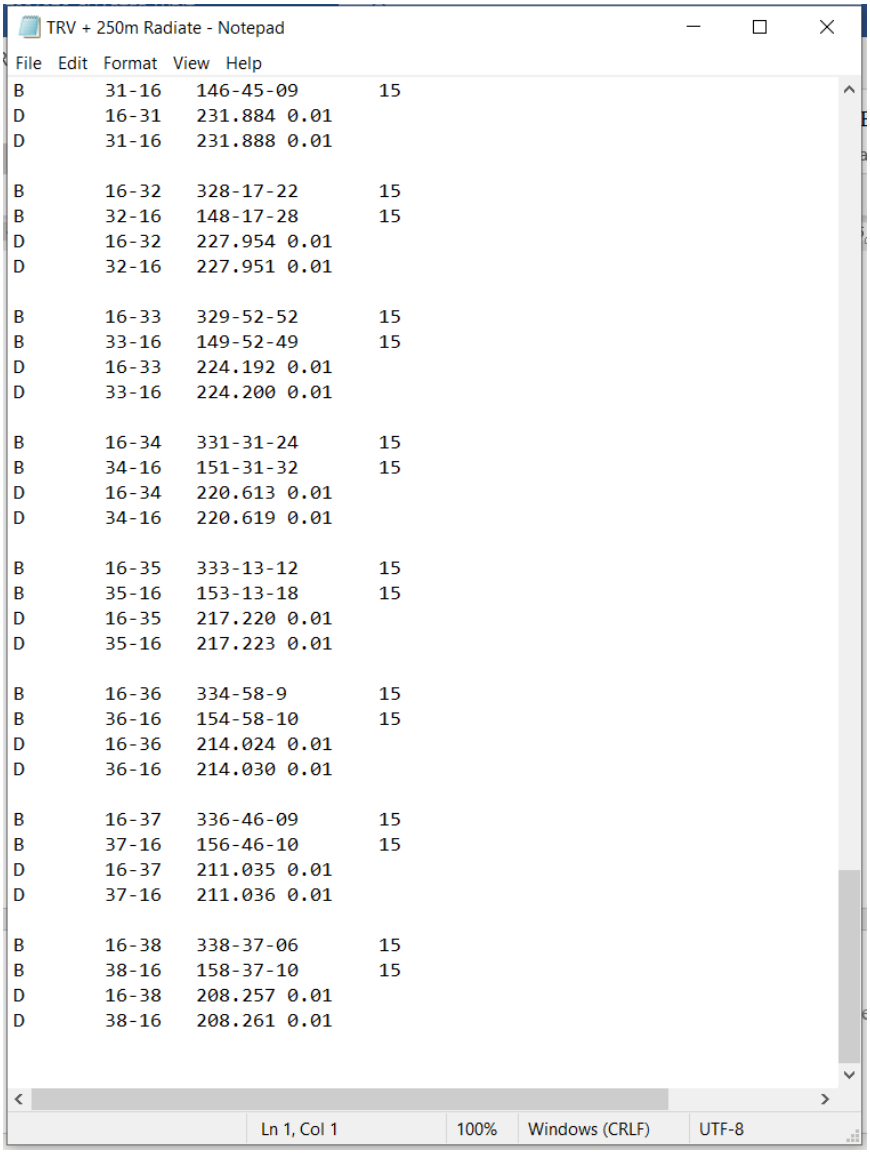
TRV + 250m Radiate - Notepad

File Edit Format View Help

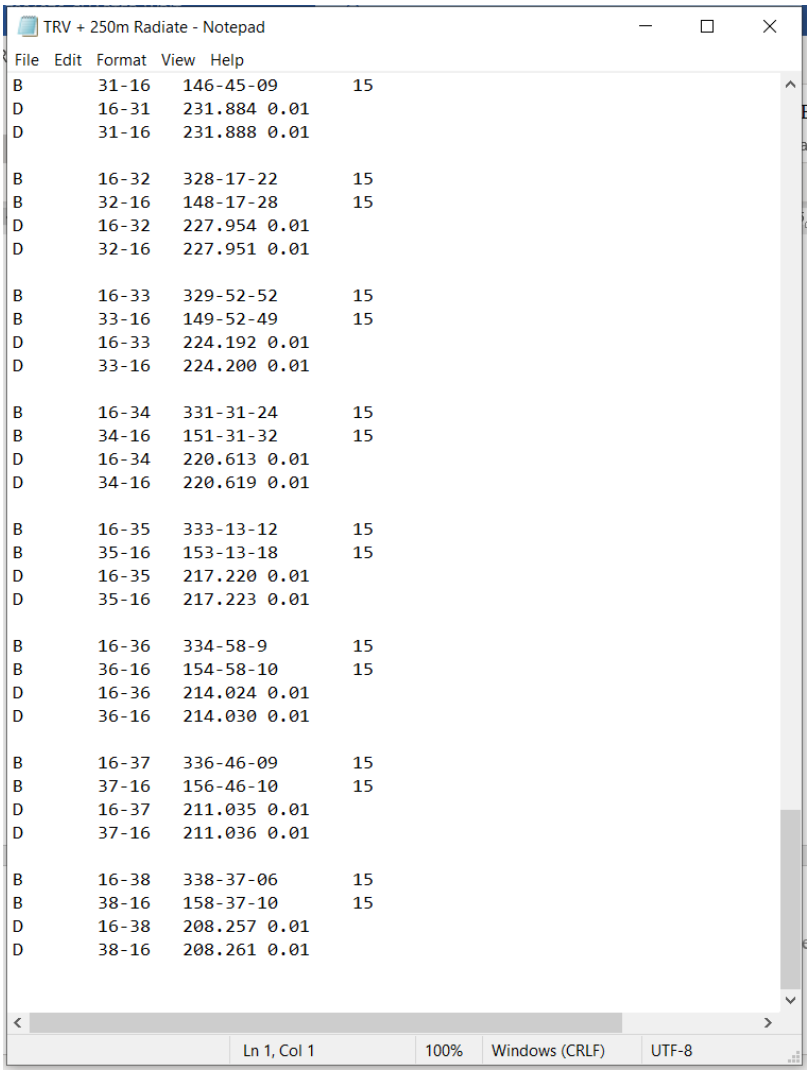
```
D       16-23   250.000 0.01
D       23-16   250.001 0.01

B       16-24   330-53-58       15
B       24-16   150-54-00       15
D       16-24   246.360 0.01
D       24-16   246.362 0.01

B       16-25   332-24-24       15
B       25-16   152-24-30       15
D       16-25   242.885 0.01
D       25-16   242.888 0.01

B       16-26   333-57-28       15
B       26-16   153-57-31       15
D       16-26   239.583 0.01
D       26-16   239.587 0.01

B       16-27   335-33-00       15
B       27-16   155-33-03       15
D       16-27   236.466 0.01
D       27-16   236.464 0.01

B       16-28   337-11-04       15
B       28-16   157-11-07       15
D       16-28   233.530 0.01
D       28-16   233.534 0.01

B       16-29   338-51-29       15
B       29-16   158-51-34       15
D       16-29   230.793 0.01
D       29-16   230.790 0.01

B       16-30   340-34-19       15
B       30-16   160-34-23       15
D       16-30   228.259 0.01
D       30-16   228.261 0.01

B       16-31   326-45-08       15
B       31-16   146-45-09       15
```

Ln 1, Col 1 100% Windows (CRLF) UTF-8

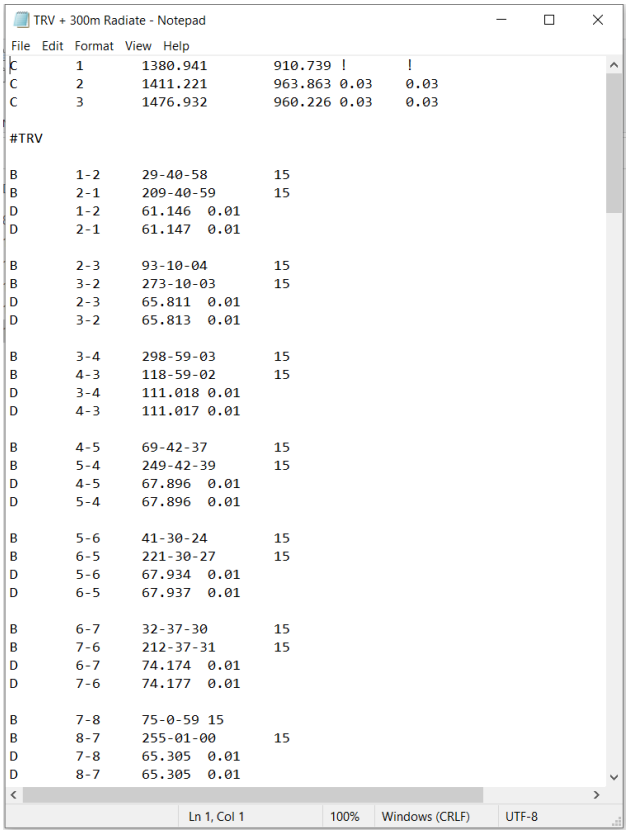
Appendix E: Input file traverse and 250m radiate

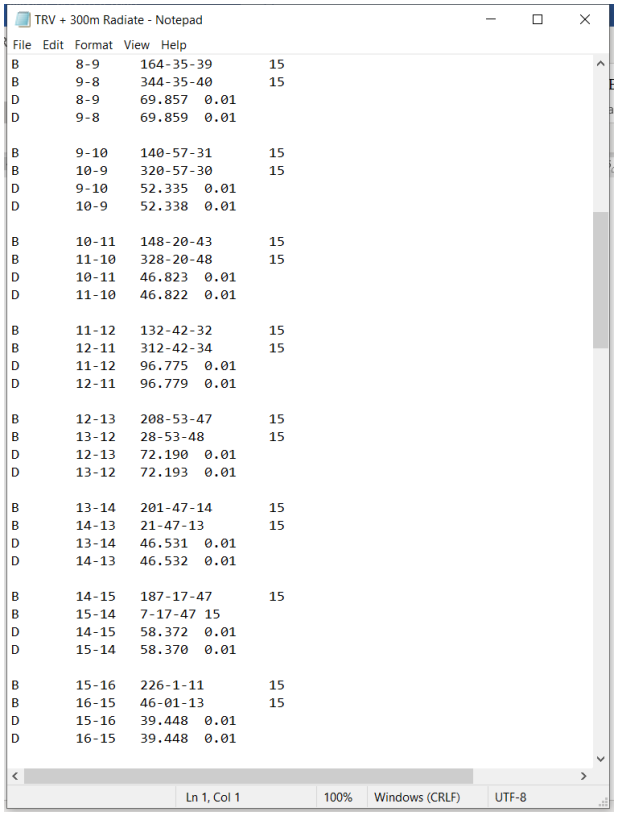


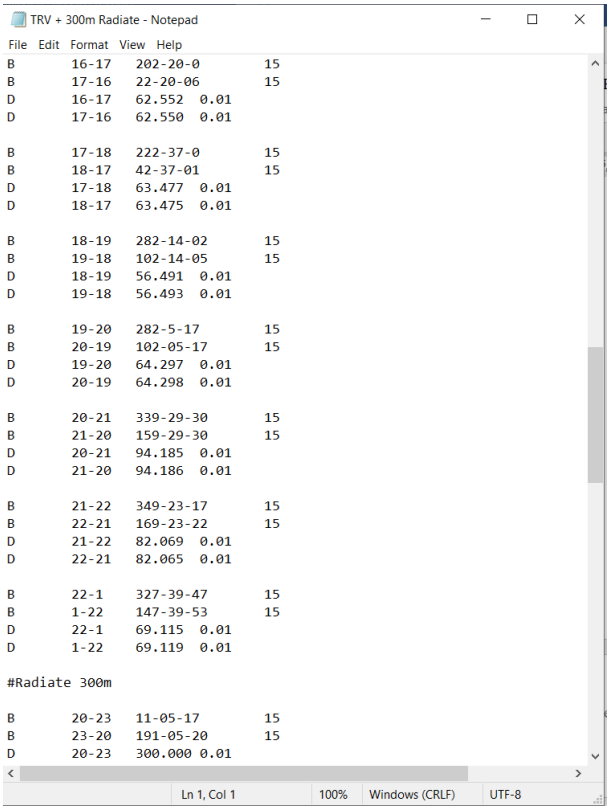
Appendix E: Input file traverse and 250m radiate



Appendix F: Input file traverse and 300m radiate





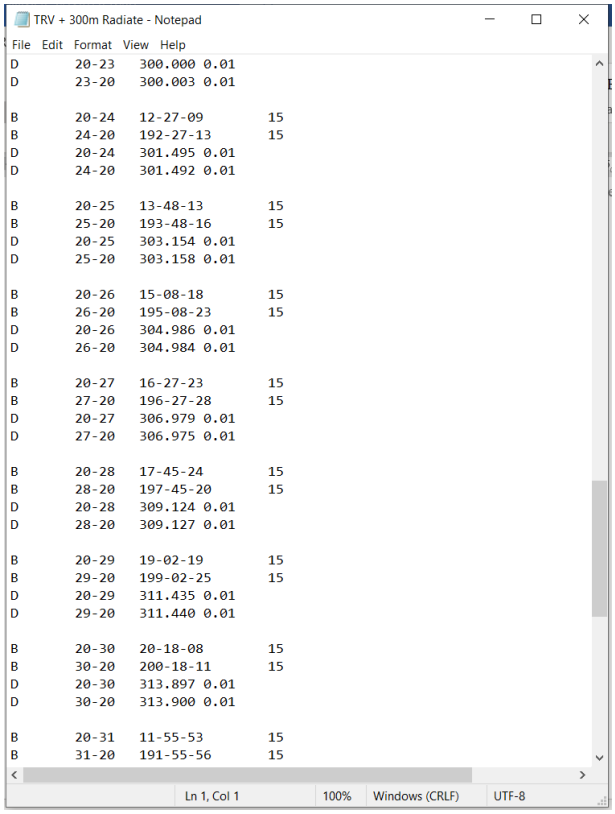


TRV + 300m Radiate - Notepad

File Edit Format View Help

```
B       16-17   202-20-0        15
B       17-16   22-20-06        15
D       16-17   62.552  0.01
D       17-16   62.550  0.01

B       17-18   222-37-0        15
B       18-17   42-37-01        15
D       17-18   63.477  0.01
D       18-17   63.475  0.01

B       18-19   282-14-02       15
B       19-18   102-14-05       15
D       18-19   56.491  0.01
D       19-18   56.493  0.01

B       19-20   282-5-17        15
B       20-19   102-05-17       15
D       19-20   64.297  0.01
D       20-19   64.298  0.01

B       20-21   339-29-30       15
B       21-20   159-29-30       15
D       20-21   94.185  0.01
D       21-20   94.186  0.01

B       21-22   349-23-17       15
B       22-21   169-23-22       15
D       21-22   82.069  0.01
D       22-21   82.065  0.01

B       22-1    327-39-47       15
B       1-22    147-39-53       15
D       22-1    69.115  0.01
D       1-22    69.119  0.01

#Radiate 300m

B       20-23   11-05-17        15
B       23-20   191-05-20       15
D       20-23   300.000 0.01
```

Ln 1, Col 1 100% Windows (CRLF) UTF-8



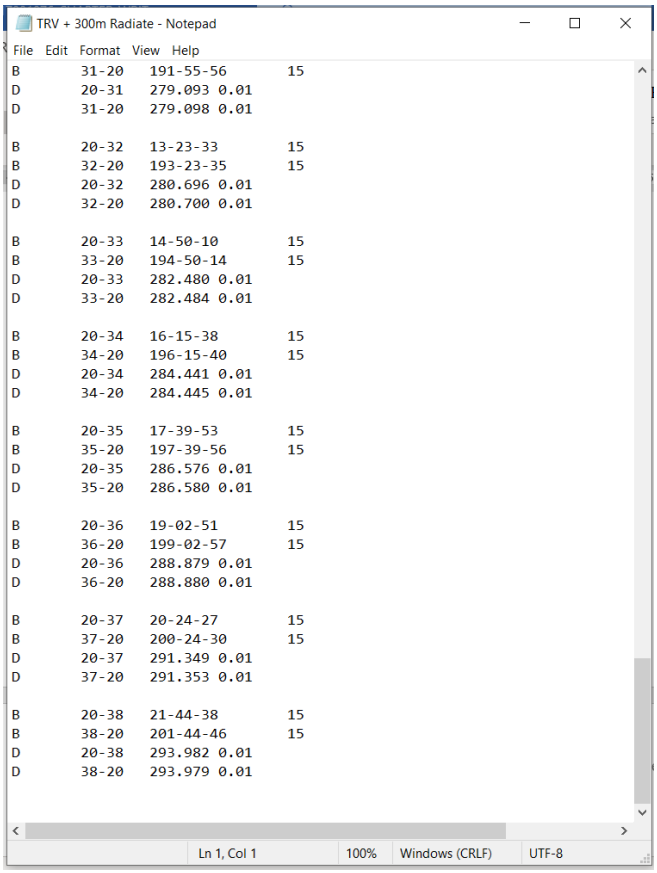
TRV + 300m Radiate - Notepad

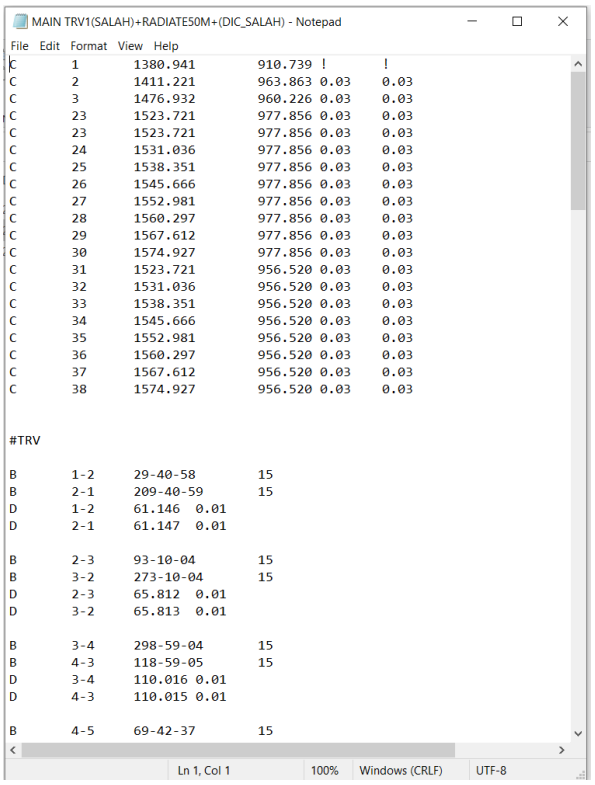
File Edit Format View Help

```
D       20-23   300.000 0.01
D       23-20   300.003 0.01

B       20-24   12-27-09        15
B       24-20   192-27-13       15
D       20-24   301.495 0.01
D       24-20   301.492 0.01

B       20-25   13-48-13        15
B       25-20   193-48-16       15
D       20-25   303.154 0.01
D       25-20   303.158 0.01

B       20-26   15-08-18        15
B       26-20   195-08-23       15
D       20-26   304.986 0.01
D       26-20   304.984 0.01

B       20-27   16-27-23        15
B       27-20   196-27-28       15
D       20-27   306.979 0.01
D       27-20   306.975 0.01

B       20-28   17-45-24        15
B       28-20   197-45-20       15
D       20-28   309.124 0.01
D       28-20   309.127 0.01

B       20-29   19-02-19        15
B       29-20   199-02-25       15
D       20-29   311.435 0.01
D       29-20   311.440 0.01

B       20-30   20-18-08        15
B       30-20   200-18-11       15
D       20-30   313.897 0.01
D       30-20   313.900 0.01

B       20-31   11-55-53        15
B       31-20   191-55-56       15
```

Ln 1, Col 1 100% Windows (CRLF) UTF-8

Appendix F: Input file traverse and 300m radiate



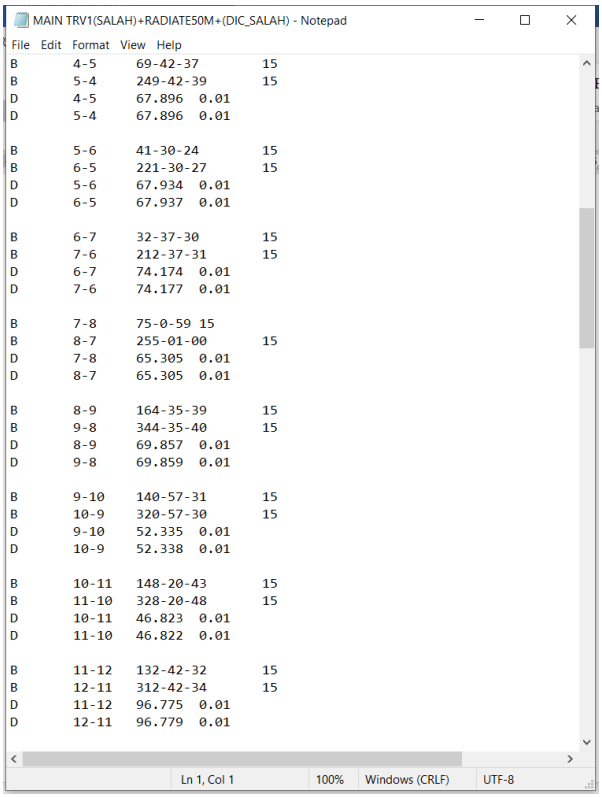


MAIN TRV1(SALAH)+RADIATE50M+(DIC_SALAH) - Notepad

File Edit Format View Help

```
C       1       1380.941        910.739 !       !
C       2       1411.221        963.863 0.03    0.03
C       3       1476.932        960.226 0.03    0.03
C       23      1523.721        977.856 0.03    0.03
C       23      1523.721        977.856 0.03    0.03
C       24      1531.036        977.856 0.03    0.03
C       25      1538.351        977.856 0.03    0.03
C       26      1545.666        977.856 0.03    0.03
C       27      1552.981        977.856 0.03    0.03
C       28      1560.297        977.856 0.03    0.03
C       29      1567.612        977.856 0.03    0.03
C       30      1574.927        977.856 0.03    0.03
C       31      1523.721        956.520 0.03    0.03
C       32      1531.036        956.520 0.03    0.03
C       33      1538.351        956.520 0.03    0.03
C       34      1545.666        956.520 0.03    0.03
C       35      1552.981        956.520 0.03    0.03
C       36      1560.297        956.520 0.03    0.03
C       37      1567.612        956.520 0.03    0.03
C       38      1574.927        956.520 0.03    0.03


#TRV

B       1-2     29-40-58        15
B       2-1     209-40-59       15
D       1-2     61.146  0.01
D       2-1     61.147  0.01

B       2-3     93-10-04        15
B       3-2     273-10-04       15
D       2-3     65.812  0.01
D       3-2     65.813  0.01

B       3-4     298-59-04       15
B       4-3     118-59-05       15
D       3-4     110.016 0.01
D       4-3     110.015 0.01

B       4-5     69-42-37        15
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

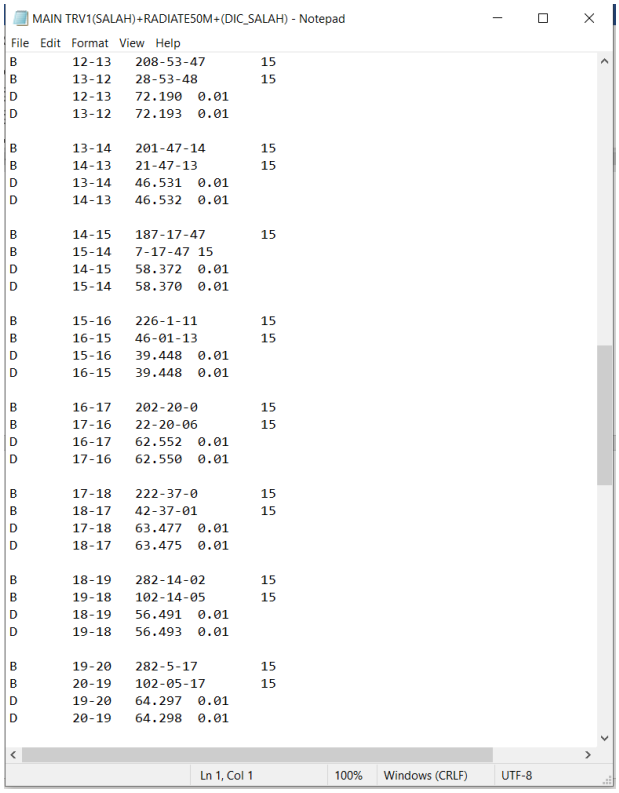


MAIN TRV1(SALAH)+RADIATE50M+(DIC_SALAH) - Notepad

File Edit Format View Help

```
B       4-5     69-42-37        15
B       5-4     249-42-39       15
D       4-5     67.896  0.01
D       5-4     67.896  0.01

B       5-6     41-30-24        15
B       6-5     221-30-27       15
D       5-6     67.934  0.01
D       6-5     67.937  0.01

B       6-7     32-37-30        15
B       7-6     212-37-31       15
D       6-7     74.174  0.01
D       7-6     74.177  0.01

B       7-8     75-0-59 15
B       8-7     255-01-00       15
D       7-8     65.305  0.01
D       8-7     65.305  0.01

B       8-9     164-35-39       15
B       9-8     344-35-40       15
D       8-9     69.857  0.01
D       9-8     69.859  0.01

B       9-10    140-57-31       15
B       10-9    320-57-30       15
D       9-10    52.335  0.01
D       10-9    52.338  0.01

B       10-11   148-20-43       15
B       11-10   328-20-48       15
D       10-11   46.823  0.01
D       11-10   46.822  0.01

B       11-12   132-42-32       15
B       12-11   312-42-34       15
D       11-12   96.775  0.01
D       12-11   96.779  0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

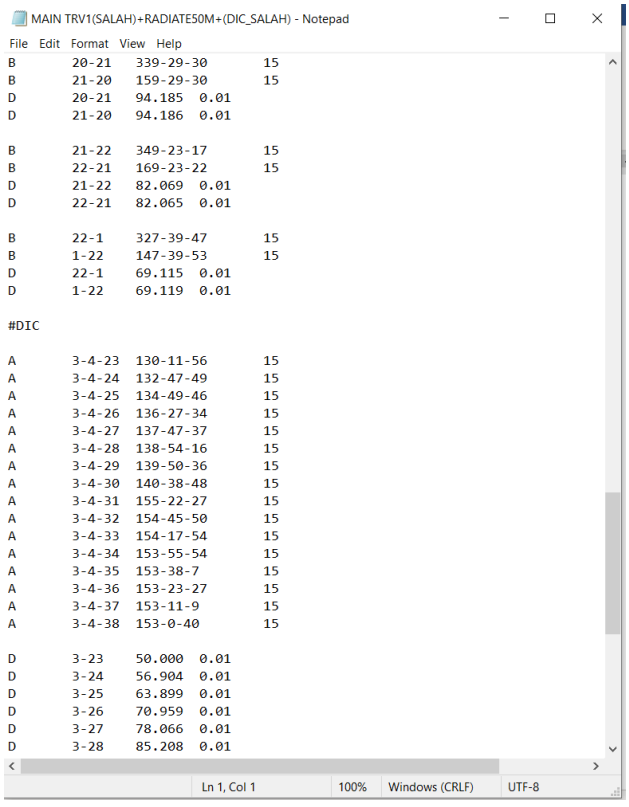


MAIN TRV1(SALAH)+RADIATE50M+(DIC_SALAH) - Notepad

File Edit Format View Help

```
B       12-13   208-53-47       15
B       13-12   28-53-48        15
D       12-13   72.190  0.01
D       13-12   72.193  0.01

B       13-14   201-47-14       15
B       14-13   21-47-13        15
D       13-14   46.531  0.01
D       14-13   46.532  0.01

B       14-15   187-17-47       15
B       15-14   7-17-47 15
D       14-15   58.372  0.01
D       15-14   58.370  0.01

B       15-16   226-1-11        15
B       16-15   46-01-13        15
D       15-16   39.448  0.01
D       16-15   39.448  0.01

B       16-17   202-20-0        15
B       17-16   22-20-06        15
D       16-17   62.552  0.01
D       17-16   62.550  0.01

B       17-18   222-37-0        15
B       18-17   42-37-01        15
D       17-18   63.477  0.01
D       18-17   63.475  0.01

B       18-19   282-14-02       15
B       19-18   102-14-05       15
D       18-19   56.491  0.01
D       19-18   56.493  0.01

B       19-20   282-5-17        15
B       20-19   102-05-17       15
D       19-20   64.297  0.01
D       20-19   64.298  0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

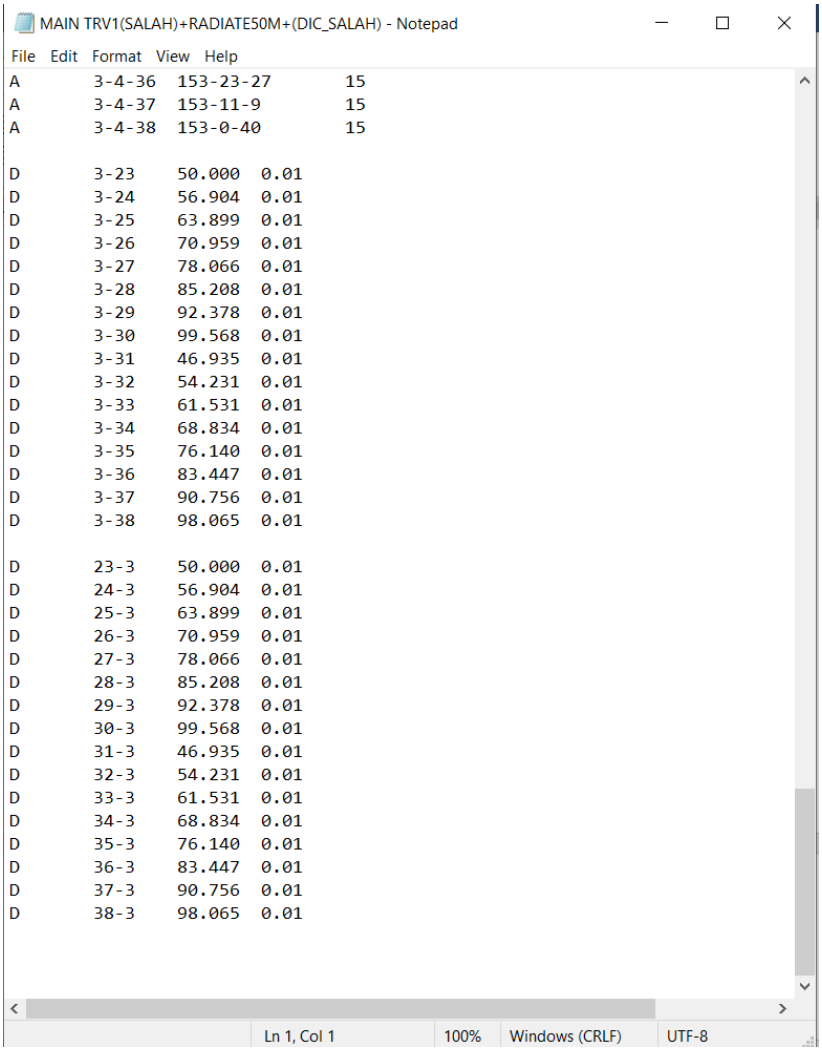


MAIN TRV1(SALAH)+RADIATE50M+(DIC_SALAH) - Notepad

File Edit Format View Help

```
B       20-21   339-29-30       15
B       21-20   159-29-30       15
D       20-21   94.185  0.01
D       21-20   94.186  0.01

B       21-22   349-23-17       15
B       22-21   169-23-22       15
D       21-22   82.069  0.01
D       22-21   82.065  0.01

B       22-1    327-39-47       15
B       1-22    147-39-53       15
D       22-1    69.115  0.01
D       1-22    69.119  0.01

#DIC

A       3-4-23  130-11-56       15
A       3-4-24  132-47-49       15
A       3-4-25  134-49-46       15
A       3-4-26  136-27-34       15
A       3-4-27  137-47-37       15
A       3-4-28  138-54-16       15
A       3-4-29  139-50-36       15
A       3-4-30  140-38-48       15
A       3-4-31  155-22-27       15
A       3-4-32  154-45-50       15
A       3-4-33  154-17-54       15
A       3-4-34  153-55-54       15
A       3-4-35  153-38-7        15
A       3-4-36  153-23-27       15
A       3-4-37  153-11-9        15
A       3-4-38  153-0-40        15

D       3-23    50.000  0.01
D       3-24    56.904  0.01
D       3-25    63.899  0.01
D       3-26    70.959  0.01
D       3-27    78.066  0.01
D       3-28    85.208  0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8


MAIN TRV1(SALAH)+RADIATE50M+(DIC_SALAH) - Notepad
File Edit Format View Help
A 3-4-36 153-23-27 15
A 3-4-37 153-11-9 15
A 3-4-38 153-0-40 15
D 3-23 50.000 0.01
D 3-24 56.904 0.01
D 3-25 63.899 0.01
D 3-26 70.959 0.01
D 3-27 78.066 0.01
D 3-28 85.208 0.01
D 3-29 92.378 0.01
D 3-30 99.568 0.01
D 3-31 46.935 0.01
D 3-32 54.231 0.01
D 3-33 61.531 0.01
D 3-34 68.834 0.01
D 3-35 76.140 0.01
D 3-36 83.447 0.01
D 3-37 90.756 0.01
D 3-38 98.065 0.01
D 23-3 50.000 0.01
D 24-3 56.904 0.01
D 25-3 63.899 0.01
D 26-3 70.959 0.01
D 27-3 78.066 0.01
D 28-3 85.208 0.01
D 29-3 92.378 0.01
D 30-3 99.568 0.01
D 31-3 46.935 0.01
D 32-3 54.231 0.01
D 33-3 61.531 0.01
D 34-3 68.834 0.01
D 35-3 76.140 0.01
D 36-3 83.447 0.01
D 37-3 90.756 0.01
D 38-3 98.065 0.01
Ln 1, Col 1
100%
Windows (CRLF)
UTF-8

MAIN TRV1(SALAH)+RADIATE50M+INTERSECT - Notepad

File Edit Format View Help

```
C       1       1380.941        910.739 !       !
C       2       1411.221        963.863 0.03    0.03
C       3       1476.932        960.226 0.03    0.03
C       23      1523.721        977.856 0.03    0.03
C       24      1531.036        977.856 0.03    0.03
C       25      1538.351        977.856 0.03    0.03
C       26      1545.666        977.856 0.03    0.03
C       27      1552.981        977.856 0.03    0.03
C       28      1560.297        977.856 0.03    0.03
C       29      1567.612        977.856 0.03    0.03
C       30      1574.927        977.856 0.03    0.03
C       31      1523.721        956.520 0.03    0.03
C       32      1531.036        956.520 0.03    0.03
C       33      1538.351        956.520 0.03    0.03
C       34      1545.666        956.520 0.03    0.03
C       35      1552.981        956.520 0.03    0.03
C       36      1560.297        956.520 0.03    0.03
C       37      1567.612        956.520 0.03    0.03
C       38      1574.927        956.520 0.03    0.03

#TRV

B       1-2     29-40-58        15
B       2-1     209-40-59       15
D       1-2     61.146  0.01
D       2-1     61.147  0.01

B       2-3     93-10-04        15
B       3-2     273-10-04       15
D       2-3     65.812  0.01
D       3-2     65.813  0.01

B       3-4     298-59-04       15
B       4-3     118-59-05       15
D       3-4     110.016 0.01
D       4-3     110.015 0.01

B       4-5     69-42-37        15
B       5-4     249-42-39       15
```

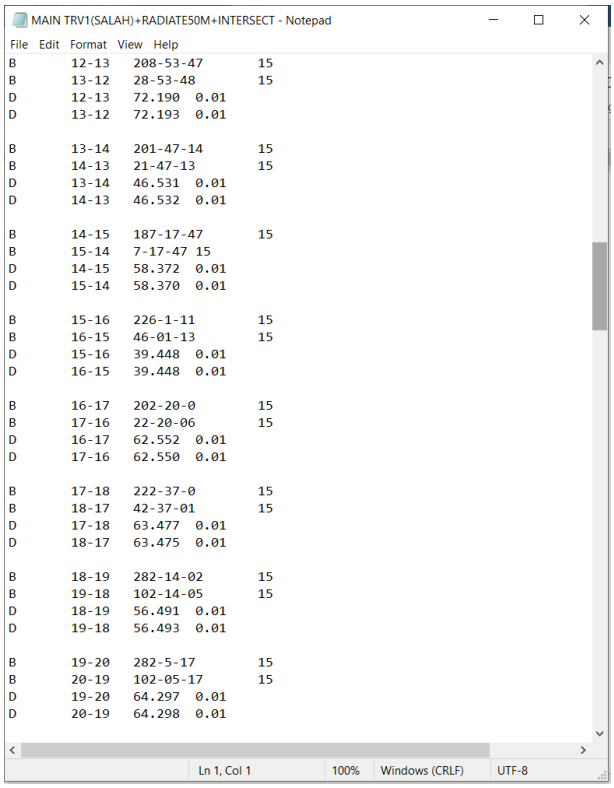
Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

MAIN TRV1(SALAH)+RADIATE50M+INTERSECT - Notepad

File Edit Format View Help

```
B       4-5     69-42-37        15
B       5-4     249-42-39       15
D       4-5     67.896  0.01
D       5-4     67.896  0.01

B       5-6     41-30-24        15
B       6-5     221-30-27       15
D       5-6     67.934  0.01
D       6-5     67.937  0.01

B       6-7     32-37-30        15
B       7-6     212-37-31       15
D       6-7     74.174  0.01
D       7-6     74.177  0.01

B       7-8     75-0-59 15
B       8-7     255-01-00       15
D       7-8     65.305  0.01
D       8-7     65.305  0.01

B       8-9     164-35-39       15
B       9-8     344-35-40       15
D       8-9     69.857  0.01
D       9-8     69.859  0.01

B       9-10    140-57-31       15
B       10-9    320-57-30       15
D       9-10    52.335  0.01
D       10-9    52.338  0.01

B       10-11   148-20-43       15
B       11-10   328-20-48       15
D       10-11   46.823  0.01
D       11-10   46.822  0.01

B       11-12   132-42-32       15
B       12-11   312-42-34       15
D       11-12   96.775  0.01
D       12-11   96.779  0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

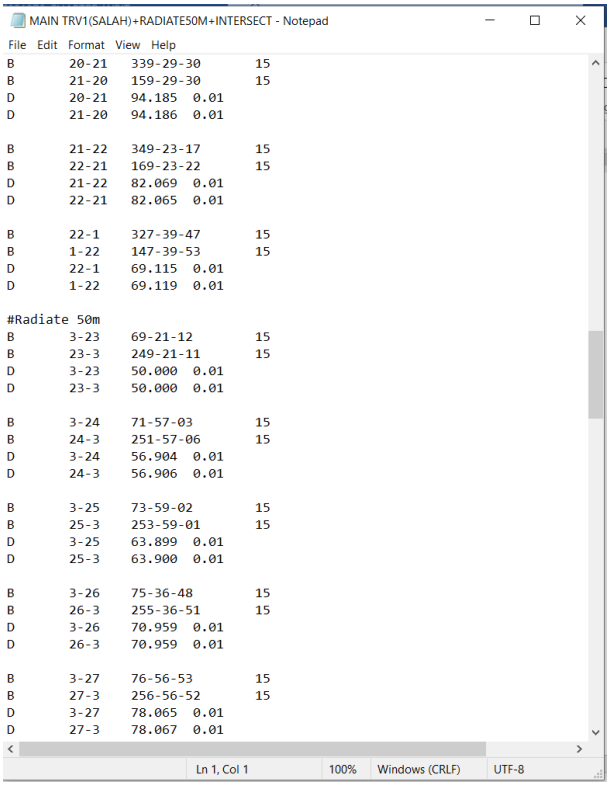


MAIN TRV1(SALAH)+RADIATE50M+INTERSECT - Notepad

File Edit Format View Help

```
B       12-13   208-53-47       15
B       13-12   28-53-48        15
D       12-13   72.190  0.01
D       13-12   72.193  0.01

B       13-14   201-47-14       15
B       14-13   21-47-13        15
D       13-14   46.531  0.01
D       14-13   46.532  0.01

B       14-15   187-17-47       15
B       15-14   7-17-47 15
D       14-15   58.372  0.01
D       15-14   58.370  0.01

B       15-16   226-1-11        15
B       16-15   46-01-13        15
D       15-16   39.448  0.01
D       16-15   39.448  0.01

B       16-17   202-20-0        15
B       17-16   22-20-06        15
D       16-17   62.552  0.01
D       17-16   62.550  0.01

B       17-18   222-37-0        15
B       18-17   42-37-01        15
D       17-18   63.477  0.01
D       18-17   63.475  0.01

B       18-19   282-14-02       15
B       19-18   102-14-05       15
D       18-19   56.491  0.01
D       19-18   56.493  0.01

B       19-20   282-5-17        15
B       20-19   102-05-17       15
D       19-20   64.297  0.01
D       20-19   64.298  0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8

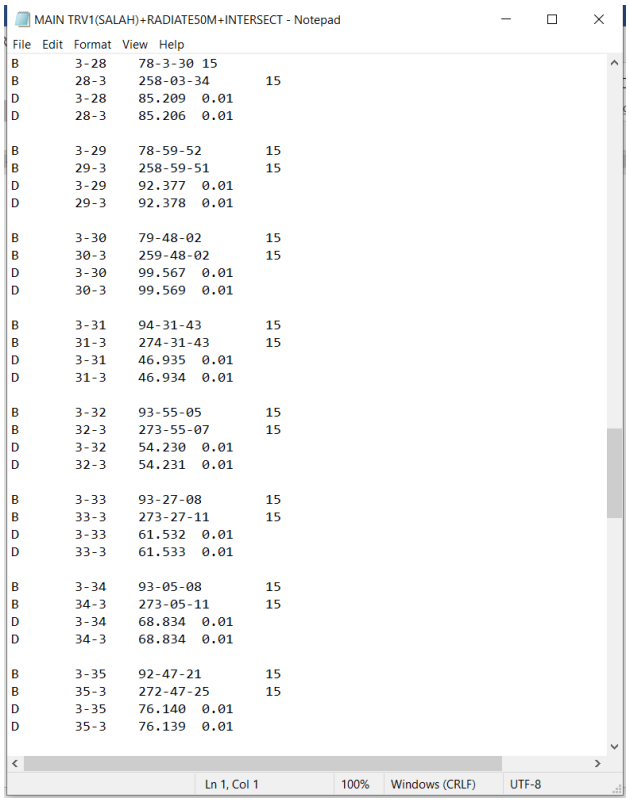


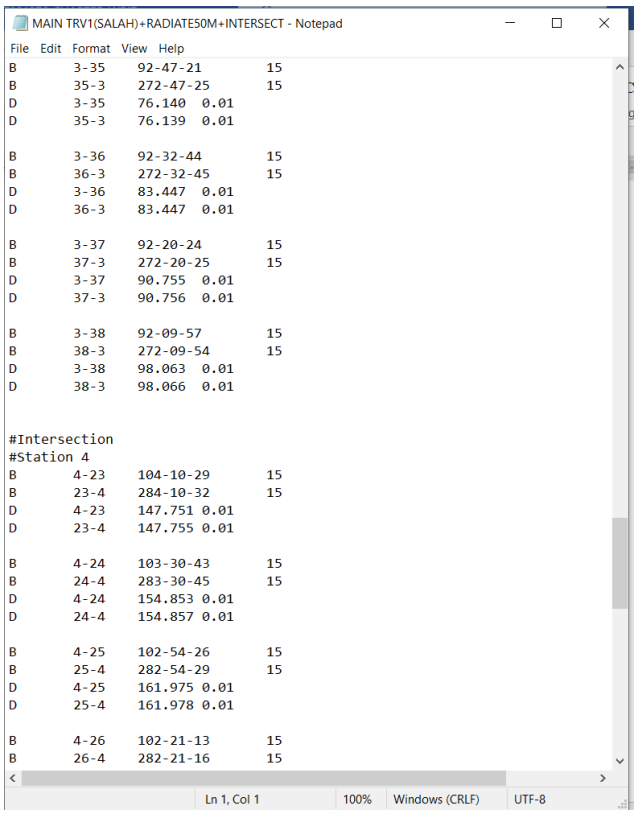
MAIN TRV1(SALAH)+RADIATE50M+INTERSECT - Notepad

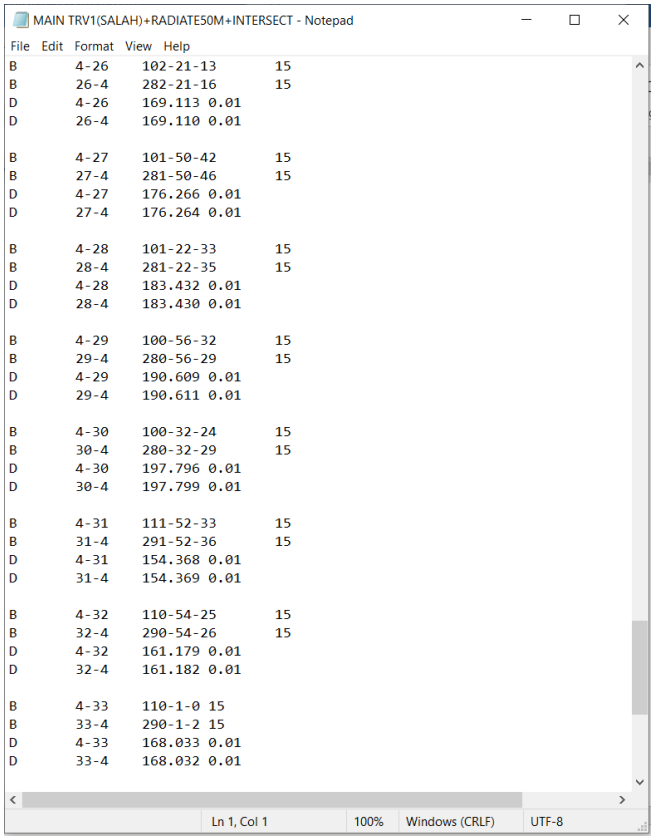
File Edit Format View Help

```
B       20-21   339-29-30       15
B       21-20   159-29-30       15
D       20-21   94.185  0.01
D       21-20   94.186  0.01

B       21-22   349-23-17       15
B       22-21   169-23-22       15
D       21-22   82.069  0.01
D       22-21   82.065  0.01

B       22-1    327-39-47       15
B       1-22    147-39-53       15
D       22-1    69.115  0.01
D       1-22    69.119  0.01

#Radiate 50m
B       3-23    69-21-12        15
B       23-3    249-21-11       15
D       3-23    50.000  0.01
D       23-3    50.000  0.01

B       3-24    71-57-03        15
B       24-3    251-57-06       15
D       3-24    56.904  0.01
D       24-3    56.906  0.01

B       3-25    73-59-02        15
B       25-3    253-59-01       15
D       3-25    63.899  0.01
D       25-3    63.900  0.01

B       3-26    75-36-48        15
B       26-3    255-36-51       15
D       3-26    70.959  0.01
D       26-3    70.959  0.01

B       3-27    76-56-53        15
B       27-3    256-56-52       15
D       3-27    78.065  0.01
D       27-3    78.067  0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8


MAIN TRV1(SALAH)+RADIATE50M+INTERSECT - Notepad
File Edit Format View Help
B 3-28 78-3-30 15
B 28-3 258-03-34 15
D 3-28 85.209 0.01
D 28-3 85.206 0.01
B 3-29 78-59-52 15
B 29-3 258-59-51 15
D 3-29 92.377 0.01
D 29-3 92.378 0.01
B 3-30 79-48-02 15
B 30-3 259-48-02 15
D 3-30 99.567 0.01
D 30-3 99.569 0.01
B 3-31 94-31-43 15
B 31-3 274-31-43 15
D 3-31 46.935 0.01
D 31-3 46.934 0.01
B 3-32 93-55-05 15
B 32-3 273-55-07 15
D 3-32 54.230 0.01
D 32-3 54.231 0.01
B 3-33 93-27-08 15
B 33-3 273-27-11 15
D 3-33 61.532 0.01
D 33-3 61.533 0.01
B 3-34 93-05-08 15
B 34-3 273-05-11 15
D 3-34 68.834 0.01
D 34-3 68.834 0.01
B 3-35 92-47-21 15
B 35-3 272-47-25 15
D 3-35 76.140 0.01
D 35-3 76.139 0.01
Ln 1, Col 1
100%
Windows (CRLF)
UTF-8


MAIN TRV1(SALAH)+RADIATE50M+INTERSECT - Notepad
File Edit Format View Help
B 3-35 92-47-21 15
B 35-3 272-47-25 15
D 3-35 76.140 0.01
D 35-3 76.139 0.01
B 3-36 92-32-44 15
B 36-3 272-32-45 15
D 3-36 83.447 0.01
D 36-3 83.447 0.01
B 3-37 92-20-24 15
B 37-3 272-20-25 15
D 3-37 90.755 0.01
D 37-3 90.756 0.01
B 3-38 92-09-57 15
B 38-3 272-09-54 15
D 3-38 98.063 0.01
D 38-3 98.066 0.01
#Intersection
#Station 4
B 4-23 104-10-29 15
B 23-4 284-10-32 15
D 4-23 147.751 0.01
D 23-4 147.755 0.01
B 4-24 103-30-43 15
B 24-4 283-30-45 15
D 4-24 154.853 0.01
D 24-4 154.857 0.01
B 4-25 102-54-26 15
B 25-4 282-54-29 15
D 4-25 161.975 0.01
D 25-4 161.978 0.01
B 4-26 102-21-13 15
B 26-4 282-21-16 15
Ln 1, Col 1
100%
Windows (CRLF)
UTF-8

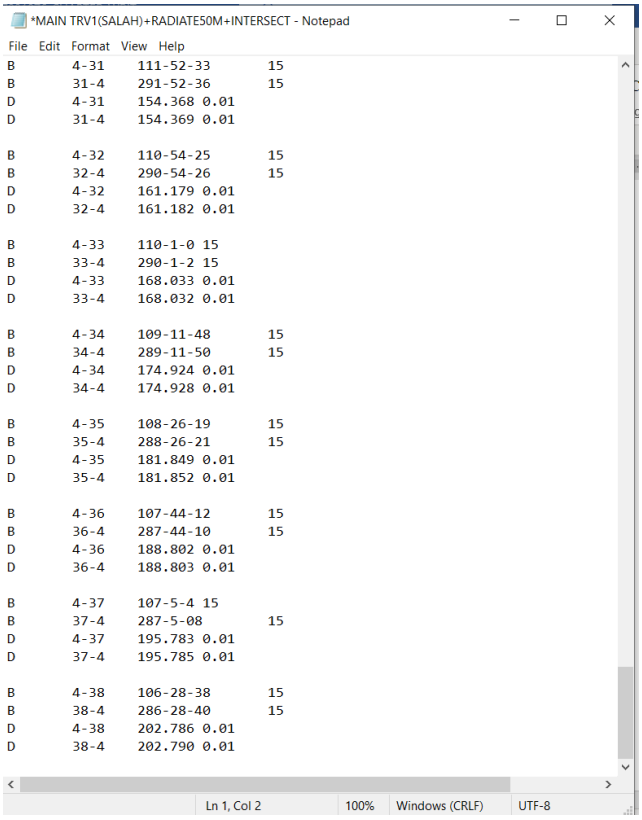


MAIN TRV1(SALAH)+RADIATE50M+INTERSECT - Notepad

File Edit Format View Help

```
B       4-26    102-21-13       15
B       26-4    282-21-16       15
D       4-26    169.113 0.01
D       26-4    169.110 0.01

B       4-27    101-50-42       15
B       27-4    281-50-46       15
D       4-27    176.266 0.01
D       27-4    176.264 0.01

B       4-28    101-22-33       15
B       28-4    281-22-35       15
D       4-28    183.432 0.01
D       28-4    183.430 0.01

B       4-29    100-56-32       15
B       29-4    280-56-29       15
D       4-29    190.609 0.01
D       29-4    190.611 0.01

B       4-30    100-32-24       15
B       30-4    280-32-29       15
D       4-30    197.796 0.01
D       30-4    197.799 0.01

B       4-31    111-52-33       15
B       31-4    291-52-36       15
D       4-31    154.368 0.01
D       31-4    154.369 0.01

B       4-32    110-54-25       15
B       32-4    290-54-26       15
D       4-32    161.179 0.01
D       32-4    161.182 0.01

B       4-33    110-1-0 15
B       33-4    290-1-2 15
D       4-33    168.033 0.01
D       33-4    168.032 0.01
```

Ln 1, Col 1 | 100% | Windows (CRLF) | UTF-8



*MAIN TRV1(SALAH)+RADIATE50M+INTERSECT - Notepad

File Edit Format View Help

```
B       4-31    111-52-33       15
B       31-4    291-52-36       15
D       4-31    154.368 0.01
D       31-4    154.369 0.01

B       4-32    110-54-25       15
B       32-4    290-54-26       15
D       4-32    161.179 0.01
D       32-4    161.182 0.01

B       4-33    110-1-0 15
B       33-4    290-1-2 15
D       4-33    168.033 0.01
D       33-4    168.032 0.01

B       4-34    109-11-48       15
B       34-4    289-11-50       15
D       4-34    174.924 0.01
D       34-4    174.928 0.01

B       4-35    108-26-19       15
B       35-4    288-26-21       15
D       4-35    181.849 0.01
D       35-4    181.852 0.01

B       4-36    107-44-12       15
B       36-4    287-44-10       15
D       4-36    188.802 0.01
D       36-4    188.803 0.01

B       4-37    107-5-4 15
B       37-4    287-5-08        15
D       4-37    195.783 0.01
D       37-4    195.785 0.01

B       4-38    106-28-38       15
B       38-4    286-28-40       15
D       4-38    202.786 0.01
D       38-4    202.790 0.01
```

Ln 1, Col 2 | 100% | Windows (CRLF) | UTF-8